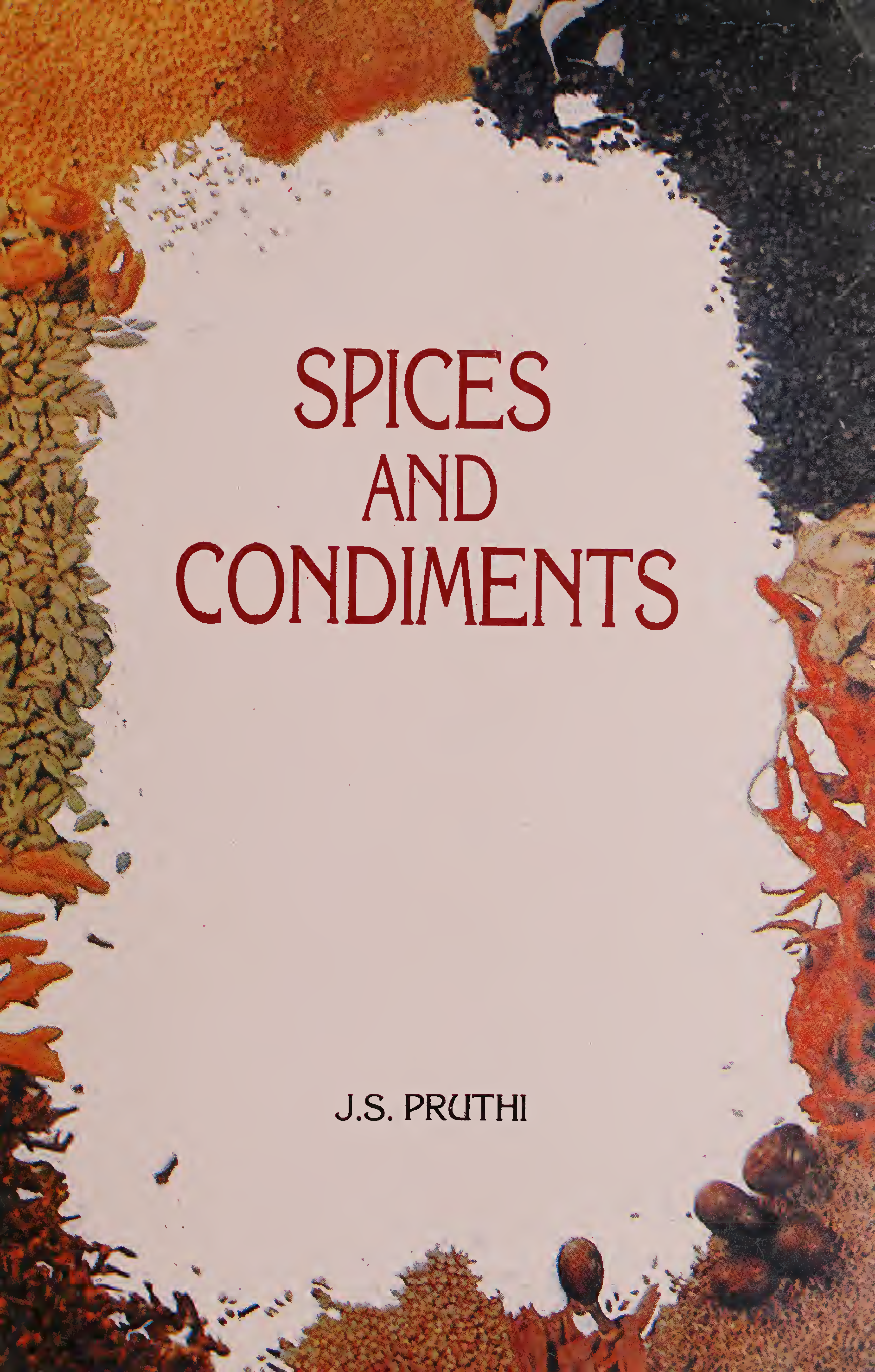

SPICES AND CONDIMENTS

J.S. PRUTHI

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India—The Land and the People

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J. S. PRUTHI

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CONTENTS

PREFACE TO THE FIRST EDITION

In Mediaeval times, the word 'India' conjured up a vision in the minds of foreigners of a land of maharajas, diamonds, fine textiles, ivory and, of course, spices too. India is now advancing as an industrial nation and is slowly and steadily staking her claims to advanced technology. But as before, the world still looks upon India as the "Home of Spices." The reason is not far to seek as the quality of the spices produced in and exported from India has been and continues to be undisputedly one of the best.

In ancient times, spices ranked with precious stones in the inventory of royal possessions and were monopolized by the few. They determined the wealth and policies of nations and also played an important role in ancient medicine. Besides, they also provided an incentive for the discovery of new waterways and new continents.

Even today, spices and condiments play quite an important role in the national economies of several spice producing, importing and exporting countries. There is a considerable volume of international trade in spices. India is one of the major spice producing and exporting countries of the world. According to the latest figures compiled by the Spices Export Promotion Council, Cochin, the export of spices from India during 1980-90 earned valuable foreign exchange worth Rs 1000 to 3086 millions per annum.

Despite the tremendous importance of spices, it is rather unfortunate that India has not produced a single publication which covers information of general interest to the layman on all the 70 spices. This is felt all the more in view of the fact that India is considered to be the "Home of Spices." In this regard, the National Book Trust of India deserves our warm felicitations for having thought of bringing out this small

handbook on spices for the benefit of the interested readers, thus presenting in a concise form the available voluminous information lying scattered in old, out of print, rare and costly publications or magazines which may not be easily available to the man on the street or even to technical hands.

Each spice in this book is covered under the following sub-heads: Nomenclature, description, distribution, quality or composition, and uses. It is a common experience, that the same spice is known by different vernacular names in different parts of the country. In order to help identify the correct spices, alongwith the Indian vernacular names, the common English names as well as the scientific or botanical names have also been given in respect of each of the 80 spices, as recently approved by the International Organization for Standardization (ISO). The value of scientific names is that they are international and enable one to initiate and continue investigations on any particular spice in any part of the world. After all, most of the spice plants are cosmopolitan by nature and many of them have been thriving well since then in their new lands.

For better understanding of the subject, in addition to the vernacular and botanical names, illustrations are also necessary, particularly for less known or uncommon minor spices. This also has been attended to in a limited way.

This publication is not claimed to be exhaustive by any means. The author is fully conscious of this limitation due to paucity of space, but it is felt that the brief description of each spice as given herein, may provide the necessary general background to the reader. For more detailed information, the interested reader can refer to the Bibliography.

The present publication is a non-technical or semi-technical one with a sincere effort to make it as simple as possible, but in a subject like this, the inclusion of some descriptive, technical or botanical terms is unavoidable. Therefore, to assist the reader, a comprehensive glossary has been provided explaining such technical terms. Likewise, while describing the medicinal uses of spices, some technical medical words also do creep in, but again, to assist the readers in the proper understanding of the medicinal properties of spices (about which the majority of the common people may not be fully

aware), another small glossary has also been appended, covering the brief explanation of the various medical terms used in the text.

Agricultural, technological, packaging, storage, insect and microbial infestation and their control measures, quality control, standardization and marketing aspects have been intentionally left out to avoid making the publication too bulky and technical. These subjects are covered in another highly technical book by the same author (J.S. Pruthi), published in USA by Academic Press, Inc. New York and 2 books on agricultural aspects have been published by the Indian Council of Agri. Research, New Delhi.

While preparing this little publication, the author had to heavily fall back upon a number of previous works, articles, reports, pamphlets, reprints, bulletins, etc. from India and abroad for which the author feels grateful to all concerned. Space does not permit detailed references. However, for the benefit of readers interested in obtaining more detailed information on the subject, the bibliography given at the end has been split into two parts, general and selected references on each important spice separately.

To collate, to process and to compress the available published information scattered in thousands of Indian and foreign journals and other diverse sources into a small handbook like this is by no means an easy task, but the assignment is rewarding in the rich experience gained and in the feeling of having been, in a limited way, of some humble service to the common man and to the spice industry in particular in projecting the importance of spices and condiments with regard to their use to man and the tremendous role they play in the national economy of our country. It also gives satisfaction to the author that this publication is being brought out just at a time when his own Alma Mater (CFTRI, Mysore) is celebrating its Silver Jubilee year on the successful completion of 25 years of dedicated service to the Nation in general and the food industries in particular.

Trichur, Kerala J.S. PRUTHI

Feb., 1976

PREFACE TO THE THIRD EDITION

It is gratifying to note that this first popular Indian handbook on spices has been well received both in India and abroad, as judged from (a) its excellent book reviews published in standard Indian and international journals and (b) its becoming out-of-print in a short span of just two years since its first release in December 1976. Its popularity, authenticity and utility can further be assessed as *firstly*, this book is serving as a 'Reference Work' for guidance in civil courts, including High Courts and Supreme Court on cases of litigation on adulteration in spices; *secondly*, it is also serving as a 'text book' in several Agricultural Universities; *thirdly*, it has been found to be handy and useful to Professors, Lecturers, Advocates and other users in the persuit of their respective professions, etc. and *fourthly*, handy to housewife and public in general.

Keeping in view the growing importance of this book and also encouraged by the fairly rapid sales of its first two editions, this edition has been suitably revised, updated and enlarged. Annexures I and II on export and production of spices, respectively have been re-written and updated. On repeated demands, a new annexure on the minimum quality standards of spices prescribed under the Prevention of Food Adulteration Act 1984 (PFA), which are mandatory for all concerned—the producers, the merchants, the processors and the consumers alike, has been added. Besides, over two dozen new photographs of important as well as unfamiliar spices have been added. The cover has also been improved. The text regarding acreage, production and export of individual spices has also been updated throughout the book.

The author is grateful to the professional reviewers, spice scientists and technologists, advocates and other users for their encouraging remarks and useful suggestions. It is hoped

that this 3rd revised and enlarged edition will be more useful to all its readers.

New Delhi J.S. Pruthi
5 August, 1985

PREFACE TO THE FOURTH EDITION

It is heartening to note the growing popularity of this original publication which is the first of its kind in India and possibly in Asia.

On popular demand this book first published in 1976 is again being printed for the fourth time. I have taken this opportunity for revising and updating this work. It is hoped the readers will find the book interesting and informative.

New Delhi
2 August 1991

J.S. PRUTHI

ACKNOWLEDGEMENTS

The Author is highly obliged to different Central and State government, agricultural departments, institutions and other organisations for the excellent co-operation extended to him in supplying the desired information, re-prints of papers and in some cases, photographs too. Special mention must be made of the Secretary, Spices Export Promotion Council, (SEPC), Cochin, (Kerala); Director General, I.C.A.R., New Delhi (Simla mirch, Black pepper plantation, tamarind and nutmeg); Director, Cocoa, Arecanut & Spices Development, Government of India, Calicut (cloves (2); cinnamon and vanilla bean); Director, Central Plantation Crops Research Institute, Kasaragod; American Spice Trade Association, (ASTA), New York and a host of spice scientists from national laboratories, agricultural universities and research institutes in India and abroad. The author is also grateful to the Director, CFTRI, Mysore and the Director General, CSIR, New Delhi for their kind encouragement in this scientific work of national and international importance.

J.S. Pruthi

ABBREVIATIONS

α	Alpha
Av.	Average
β	Beta
B.P.	British Pharmacopea
c	About or approximately
°C	Degree Celsius
d	dextro-rotatory
(α) D	Optical rotation
d 20	Density at 20°
diam.	Diameter
dig. nutr.	Digestible Nutrients
Ester no.	Ester number
Fe	Iron
FFA	Free Fatty Acids
γ	Gama
g	Grammes
HCL	Hydrochloric Acid
Insol. Ash	Insoluble Ash
I.P.	Indian Pharmocopea
I.P.C.	Indian Pharmaceutical Codex
I.S.I.	Indian Standard Institution
I.S O.	International Organisation for Standardisation
I.U.	International Units
l	Lavo-rotatory
m	meter
m.p.	melting point
mg	milligramme
ml	millilitre
μ	mew (one thousandth of a millimetre)
μg	microgramme
Niacin	Nicotinic acid
N-free-Extr.	Nitrogen Free Extract
nD 20	Refractive Index at 20°C
Opt. rot.	Optical rotation
P	Phosphorus
R.M. Val	Reichert & Missel Value
Ref. Index	Refractive index

Sap. Val.	Saponification Value
Sol. Ash	Soluble Ash
Sp. Gr.	Specific Gravity
Tons	Tonnes
Unsap. mat.	Unsaponifiable matter
U.S.P.	United States Pharmocopea
Vol.	Volume

INTRODUCTION

SPICES AND CONDIMENTS need no introduction, since India is known the world over as "The Home of Spices". Spices constitute an important group of agricultural commodities which are virtually indispensable in the culinary art. They also play a significant role in our national economy and so also in the national economies of several spice producing, exporting and importing countries. For instance, during the year 1989-90 India earned foreign exchange to the tune of over Rs. 274 crores through the export of about 99,886 tons of different spices (*see* Annexure I). Besides, huge quantities of spices are also being consumed within the country for flavouring foods and are also used in medicine, pharmaceutical, perfumery, cosmetics and several other industries.

According to the International Organization for Standardization (ISO), there is no clear-cut division between 'spices' and 'condiments' and as such they have been clubbed together. The term 'spices and condiments' applies to "such natural plant or vegetable products or mixtures thereof, in whole or ground form, as are used for imparting flavour, aroma and piquancy to and for seasoning of foods".

There are about 70 spices grown in different parts of the world. Many of these are grown in India. Spices may comprise different plant components or parts such as *Floral parts* (cloves, saffron, etc.), or *Fruits* (cardamom, chillies, etc.), or *Berries* (allspice, black pepper, juniper), or *Seeds* (aniseed, caraway, celery, coriander), or *Rhizomes* (ginger, turmeric), or *Roots* (angelica, horse-radish and lovage), or *Leaves* (bay leaves, mints, marjoram and tejpat), or *Kernel* (nutmegs), or *Aril* (mace), or *Bark* (cinnamon and cassia), or *Bulbs* (garlic, onion, etc.), or other parts of spice plants.

Spices are well-known as appetizers and are considered

essential in the culinary art all over the world. They add a tang and flavour to otherwise insipid foods. Some of them also possess anti-oxidant properties, while others are used as preservatives in some foods like pickles and chutneys, etc. Some spices also possess strong anti-microbial and antibiotic activities. Many of them possess medicinal properties and have a profound effect on human health, since they affect many functional processes. For instance, spices intensify salivary flow and the secretion of amylase, neuraminic acid and hexosamines. They favour the cleansing of the oral cavity from food adhesion and bacteria, they may help to check infection and caries, and to protect the mucous membrane against thermic, mechanical and chemical irritation. Spices increase the secretion of saliva rich in ptyalin which facilitates starch digestion in the stomach, rendering the meals which are rich in carbohydrates, more digestible. Spices possibly activate the adreno-cortical function and fortify resistance and physical capacity. Stroke volume, blood pressure, and stroke frequency can be markedly diminished or augmented by means of spices. The significance of these possibilities is evident with regard to the ailing, on the one hand, and to the performance-conscious sportsman. Spices inhibit thrombus formation and accelerate thrombolysis. All these important physiological and medicinal aspects of spices and condiments deserve our serious consideration and further thorough probe wherever necessary.

Brief History of Spices

The fame of Indian spices is older than the recorded history. Centuries before Greece and Rome had their birth, sailing ships were carrying to Mesopotamia, Arabia and Egypt the Indian spices, perfumes and textiles. It was the lure of these that brought many seafarers to the shores of India.

Long before the Christian era, the Greek merchants thronged the markets of South India, buying spices among other precious things. Epicurean Rome was spending a fortune on Indian spices, silks, brocades and cloth of gold, etc. The Parthian wars are believed to have been fought by Rome largely to keep open the trade route to India. It is also said that there might

have been no crusades and no expeditions to the East without the lure of Indian spices and her other famed products.

Today when spices cost so little, it seems unbelievable that they were once a royal luxury and that men were willing to risk their lives in quest of them. It was in the year 1492 that Christopher Columbus discovered the New World. Five years later, four tiny ships sailed southward from the port of Lisbon, Portugal, under the guidance of Captain Vasco Da Gama. Like Columbus, Vasco Da Gama too was searching for a new route to the spice lands of Asia. While Columbus failed to achieve that goal, Da Gama succeeded. In a two-year, 24,000 mile round trip, he took his ships around the continent of Africa to India and back to Lisbon. Only two of the four ships survived to reach their home port. These two ships brought back a cargo of spices and other products worth 60 times the cost of the said voyage!

The spices of the East were valuable in Da Gama's time, as they had been for centuries, because they could be used to stretch Europe's inadequate supply of food. During these Middle Ages, a pound of ginger was worth a sheep, a pound of mace worth three sheep or half a cow! Pepper, the most valuable spice of all, was counted out in individual peppercorns, and a sack of pepper was said to be worth a man's life! Ga Dama's successful voyage intensified an international power struggle for control over the spice trade. For three centuries afterward the nations of Western Europe—Portugal, Spain, France, Holland and Great Britain—fought bloody sea-wars over the spice-producing colonies.

In a nutshell, the fascinating history of spices, is a story of adventure, exploration, conquest and fierce naval rivalry.

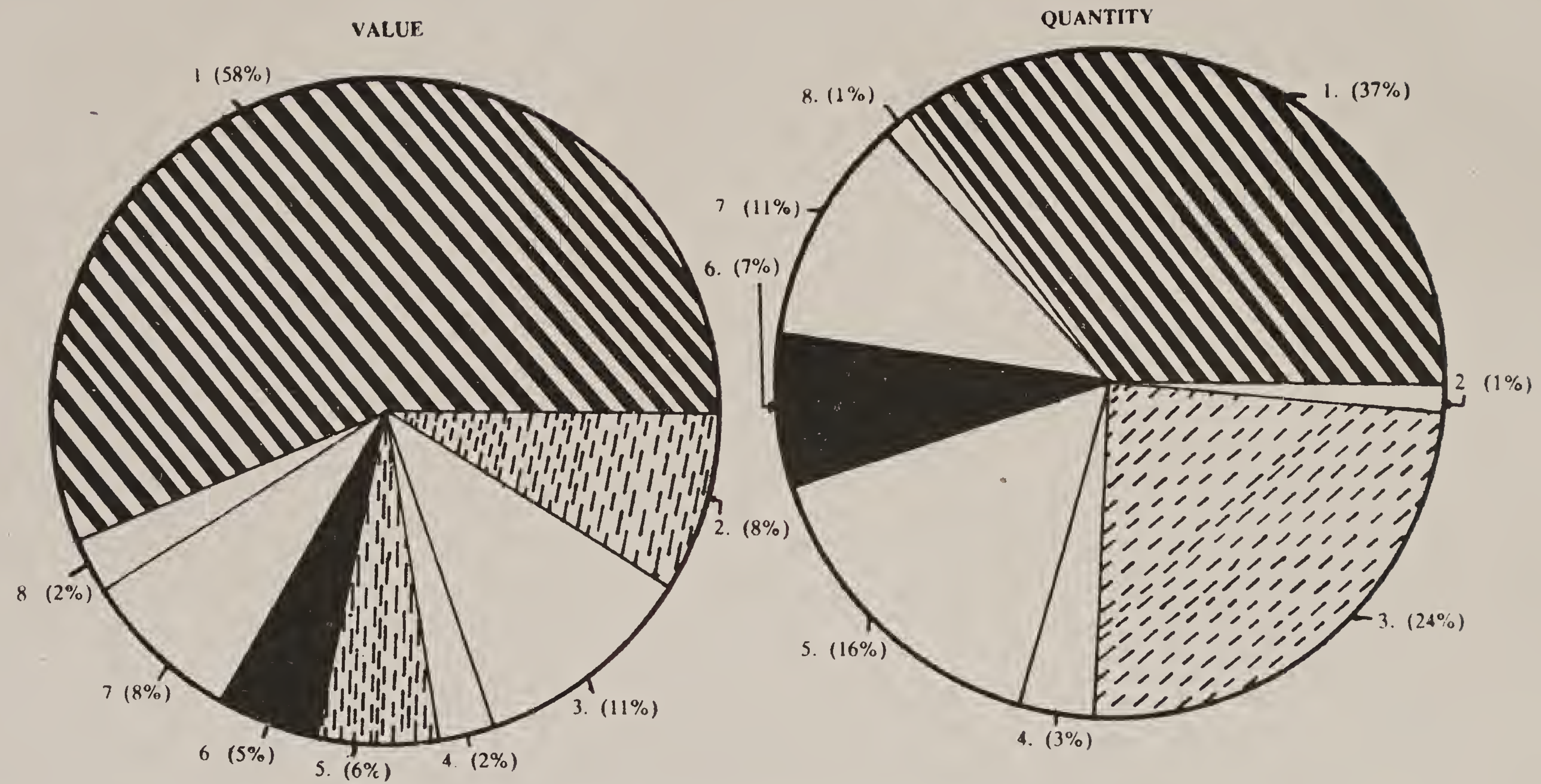
The people of those times used spices, as we do today, to enhance or vary the flavours of their foods. Spices were also flavour disguisers, masking the taste of the tainted food that was still nutritious, but would, if unspiced, have to be thrown away. Some spices were also used for preserving food like meat for a year or more without refrigeration! In the sixteenth century, cloves, for instance, were among the spices used to preserve food without refrigeration. Cloves contain a chemical called eugenol that inhibits the growth of bacteria.

It is still used to preserve some modern foods like virginia ham. Likewise, later, mustard and ground mustard were also found to have preservative qualities When spices were not available people went hungry because they could not preserve their foods to carry them over to the winter. Such was the economic importance of spices those days.

The value of the world trade in spices in 1990 was about 1500 million dollars, equivalent to over Rs. 38 thousand millions (ITC). India alone contributes 25-30 per cent of the total world trade. It may be interesting to note that nine spices, namely, pepper, ginger, cloves, cinnamon, cassia, mace, nutmeg, pimento (allspice) and cardamom alone contributed as much as 90 per cent of the total world trade. Pepper is the most important spice in the world. Among the importing countries, the USA is the largest importer. Recently, the USSR too has become an important market. Several other countries like Australia, Britain, Canada, and some European countries also import spices.

In India, the major spices grown are pepper, cardamom, ginger, turmeric and chillies. Pepper is the most important spice of India, rightly termed as the 'King of Spices', and is also known as 'Black Gold of India' since during 1989-90, export of black pepper alone earned valuable foreign exchange to the tune of about Rs. 160 crores. Chillies, turmeric and ginger came next, earning about Rs. 21, 15 and 12 crores annually respectively. Thus, though spice crops are cultivated in comparatively small units as compared to food crops, they contribute a sizeable share in the international trade. The statewise area and production statistics of spices are set out in Annexure II.

During 1989-90, India exported spices worth Rs. 274 crores of which pepper alone contributed 58%, cardamom 1%, turmeric 7%, ginger 16% and chillies 11%. The rest (24%) was contributed by seed spices and other minor spices, curry powder, spice oils and oleoresins (see Fig 1). The important minor spices grown in India are ajowan, aniseed, caraway, celery, coriander, cumin, dill seed, fennel, fenugreek, garlic, onion, saffron and vanilla, etc. Unfortunately, no reliable statistics are available on the total area and production of minor spices in different states of India. All these major and minor spices are discussed



1. PEPPER 2. SPICE OILS AND OLEORESINS 3. SEED AND OTHER SPICES
4. CURRY POWDER 5. TURMERIC 6. GINGER 7. CHILLIES
8. CARDAMOM (SMALL)

Fig. 1. Spices export from India, 1989-90

individually in respect of their nomenclature, (for the purpose of their proper identification), brief description, distribution, composition and economic utilization.

Individually, spices could be classified or grouped according to different systems of classification such as according to their (a) botanical analogies or families, (b) economic importance viz, major and minor spices, (c) similarity in methods of cultivation, (d) similarity in plant parts or components such as seedy spices, leafy spices, bulbous spices, rhizomes and roots, etc. but each system has its own merits and demerits. Space does not permit in this short handbook to go into such technicalities. For simplicity and convenience of reference. the spices have been discussed one by one in an alphabetical order, irrespective of the above considerations. Of course, effort has been made to record the latest correct nomenclature and family to which each spice belongs, along with their popular English names as well as their names in Indian languages. By no means is this first popular Indian book considered exhaustive or complete in all aspects. For instance, agronomical or cultivation aspects, basic chemical, microbiological and technological aspects etc., for the obvious reason of being too technical, are outside the scope of this handbook.

It is the purpose of this compendium to compile, collate, categorise and condense the available information found scattered in different foreign and Indian magazines/books, reports and standard reference works which are not easily available to the educated layman. It is also intended to highlight the economic importance of spices and the tremendous role they play in human health about which the layman may not be fully aware. It is also proposed to stress the importance of further researches on the precise effects of different spices in different human systems, viz., digestion, circulatory and nervous systems, etc.

It is earnestly hoped that this humble attempt in bringing out this handbook on spices, though belated, will fill the gap adequately.

AJOWAN OR BISHOP'S WEED

Bot. Name : *Trachyspermum ammi (L)* Sprague
Syn. : *Carum copticum* Heirn
Family : *Umbelliferae*

Indian names

Hindustani/Hindi: *Ajowan;* Bengali: *Jowan* or *Joan;* Gujarati: *Yavan;* Kashmiri: *Jawind;* Kannada: *Oma;* Malayalam: *Omum;* Marathi: *Onva;* Oriya: *Juani;* Punjabi, Urdu: *Ajowain;* Sanskrit : *Ajamoda Yavanika*; Tamil: *Omum;* Telugu: *Vamu.*

Description and Distribution

Ajowan is an annual herbaceous plant bearing the greyish-brown fruits (seeds) which constitute the spice. It belongs to the family 'Umbelliferae' comprising 270 genera and 2700 species mostly grown in the temperate regions of the world except for a few species which are cultivated in the tropics, especially India and North Africa. In addition to Ajowan, Caraway (*Carum carvi*), Celery (*Apium graveolens*), Coriander (*Coriandrum sativum*), Cumin (*Cuminum cyminum*), Dill (*Anethum graveolens*), and Fennel (*Foeniculum vulgare*) are the other spices which also belong to the family Umbelliferae and are discussed individually later. All these umbellifers are aromatic and possess a characteristic aroma and taste.

Ajowan is grown in Iran, Egypt, Afghanistan and chiefly in India (largely in Uttar Pradesh, Bihar, Madhya Pradesh, Punjab, Rajasthan, Bengal, Tamil Nadu and Hyderabad, etc.). It is generally grown in October-November and harvested in May-June.

Composition

Ajowan seeds, like other spices, are not viewed nutritionally. They are more known as adjuncts used in small quantities for

flavouring numerous foods, as anti-oxidants, as preservatives, or in medicine or for the manufacture of essential oils for ultimate use in perfumery, essences and medicine, etc. However, for the purpose of enforcement of quality standards with the ultimate object of detection of adulteration, information on physico-chemical composition is often sought which, in brief, is as follows—moisture: 8.9%; protein: 15.4%; fat (ether extract): 18.1%; crude fibre: 11.9%; carbohydrates; 38.6%; mineral matter (total ash): 7.1%; calcium: 1.42%; phosphorous: 0.30%; iron: 14.6 mg/100g. Calorific value per 100g: 379.

Essential Oil: Steam distillation of crushed seeds yields 2.5 to 4.0% essential oil which is valued considerably in medicine on account of the presence of thymol therein. Ajowan seed is distilled in India, partly in primitive native stills and partly in more modern and large-scale distilleries located in Rao (Indore) Gwalior and Dhar. Prior to and during World War I, considerable quantities of ajowan seed were exported from India for distillation in Europe and the United States. The oil was for a long time the principal source of thymol. However, since the introduction of synthetic thymol, the distillation of ajowan oil outside India has partially ceased, and the oil has lost its former importance.

Uses

Oil of ajowan is an almost colourless to brownish liquid, possessing a characteristic odour and a sharp burning taste. On standing, a part of the thymol may separate from the oil in the form of crystals, which is sold in Indian market under the name of *ajowan ka phul* or *sat ajowan* and is much valued in medicine, as it has nearly all the properties ascribed to the ajowan seeds. This was used in surgery as an antiseptic and was also found to be of great value in the treatment of hookworm disease and appeared to be far more effective than wormseed oil (*Chenopodium ambrosioides*). This product was shown simultaneously by R. Haines in 1856 and J. Stenhouse in 1855 to be identical with thymol which was previously obtained from thyme (*Thymus vulgaris*) and was one of the

first solid essential oil fractions obtained in the seventeenth century. The aqueous solution of thymol is an excellent mouth-wash and thymol is a constituent of many toothpastes. The distillation water, the essential oil, and the thymol separated therefrom are used in India as medicine, particularly for cases of cholera.

In Medicine: Ajowan seeds are reported to be useful in flatulence, colic, atonic dyspepsia, diarrhoea, cholera, hysteria and spasmodic affections of the bowels. They produce feeling of warmth and relieve the sinking and fainting feelings which accompany bowel disorders. They are most frequently used in conjunction with asafoetida, myrobalan and rock-salt. Externally, ajowan is applied in mixtures to relieve rheumatic and neuralgic pains. A teaspoonful of the seeds with a little salt is a common domestic remedy for indigestion from irregular diet. For stomachache, cough and indigestion, the seeds are masticated, swallowed and followed by a glass of hot water. They are also useful in skin diseases. A hot poultice of the seeds is used as a dry fomentation to the chest in asthma and to the hands and feet in cholera and fainting. They check chronic discharges such as profuse expectoration from bronchitis. Extracts of seeds in 70% and 40% alcohol are toxic to *Staphylococci* and *Escherichiacoli*. The leaves are used as a vermicide. Ajowan is one of the most valuable spices for use in medicine, thereby improving human health in a number of ways mentioned above. Even the roots of ajowan plant are reported to be diuretic and carminative.

ALLSPICE OR PIMENTA

Bot. Name: *Pimenta officinalis* Lindl.
Syn. : (1) *Pimenta dioica* (L) Merr or
(2) *Eugenia pimenta* DC.
Family : *Myrtaceae*

Indian names

Kannada: *Gandamenasu;* Malayalam: *Kappalmulaku;* Tamil: *Kattukkaruva.*

Description and Distribution

Allspice or Pimenta comprises the dried unripe berries (from a bushy green tree 6-9 metres high) which are nearly globular, 4-7 mm in diameter, with a somewhat rough surface and a reddish brown colour. Pimenta is quite different from Pimiento (*Capsicum annuum*) which is a variety of red pepper. The term 'Pimento' had its origin in the initial incorrect belief of the early Spanish explorers who thought these berries to be similar to pepper. Thence came the English expression 'Jamaica Pepper' and the German 'Nalkenpfeffer'. It is now officially recognised as 'Pimenta'. The name 'Allspice' is derived from the fact that the spice is said to possess the characteristic flavour and aroma of cloves, nutmeg, cinnamon and black pepper, all combined in this one spice. Allspice is available in whole or ground form.

The Allspice tree is indigenous to West Indies and tropical Central America, growing semi-wild in Jamaica (W.I.). It is also reported to be cultivated in gardens in India, especially in Bengal, Bihar and Orissa. It is also said to grow well and fruit heavily in Bangalore. It has been recommended for growing in the hilly districts of the Karnataka State along the river valleys. It is also found to grow in poor but well-drained soil, both in high ranges up to 1065 metres above sea-level and in the plains of Kerala. It is further reported that though both the berries and the leaves produced in Wynad area of Kerala are highly flavoured, in the plains they are of inferior quality and need further investigation. There appears to be good scope

for growing allspice in all house gardens for home consumption. However, commercial cultivation will be profitable only when there is simultaneous installation of distillation plants for the recovery of Pimenta berry and leaf oils which are in great demand all over the world.

Composition

A typical analysis of allspice berries (ground) shows the following composition—moisture: 8.8%; protein: 6.0%; fat (ether extract): 6.6%; fibre: 21.6%; carbohydrates: 52.8%; total ash: 4.2%; calcium: 0.8%; phosphorus: 0.1%; sodium: 0.08%; potassium: 1.1%; iron: 7.5 mg/100g; vit. C (ascorbic acid): 39.2mg/100g.; vit. B_1 (thiamine): 0.1mg/100g.; vit. B_2 (riboflavin) : 0.06 mg; niacin: 2.9 mg and vit. A: 1445 International units; Food energy or Calorific value: 380 calories per 100g.

Allspice owes its characteristic odour to the presence of an essential oil (3.3-4.5%), concentrated mainly in the pericarp. In addition, it contains quercitannic acid (over 8%) responsible for the astringency, a soft resin with a burning taste, fixed oil (5.8%), proteins (5.8%), crude starch (20%) and traces of alkaloid.

Whole spice does not lend itself easily to adulteration but the ground spice is sometimes found adulterated with clove stems and farinaceous products etc. Pimenta berry oil is sometimes adulterated with Pimenta leaf oil.

Uses

The berries are used as a condiment, as a flavouring ingredient in ketchups, soups, sauces, pickles, canned meats, sausages, gravies, relishes, fish dishes, pies, puddings, preserves etc. They are used in the liquor industry, especially as a flavouring ingredient for mulled wines, and as a perfume in soap making. It is an important ingredient of whole mixed pickling spice, and spice mixtures viz. curry powders, mincemeat spice, pastey spice, poultry dressing, frankfurter and hamburger, etc.

Allspice is used as an aromatic stimulant in digestive troubles. Powdered fruit is used in flatulence, dyspepsia and diarrhoea. It was formerly used in medicine as an adjuvant

to tonics and purgatives; it was considered to be carminative. It is an anodyne against rheumatism and neuralgia.

Pimenta Berry Oil: The essential oil known as Pimenta Berry Oil, is obtained by steam distillation of the crushed dried berries. Its yield is 3.3 to 4.3%. It has a yellow to yellowish-red colour, darkening with age, and possesses the characteristic colour and flavour of allspice. The characteristics of the oil are as follows—Sp. gr. at 15°: 1.024-1.055; Optical Rotation—0.5° to 5.0°: Refractive Index: 1.525-1.536; and soluble in 1-2 vol. or more of 70% alcohol. It contains eugenol (65-80%) as the principal constituent.

Pimenta berry oil is used for flavouring condiments and food products and in perfumery, soap and pharmaceutical preparations. The oil replaces the ground spice with the added advantage that it avoids microbial contamination, is of more uniform quality and can be dosed more easily and accurately. The oil is used as a carminative and stimulant. It shows bactericidal, fungicidal and anti-oxidant properties.

Pimenta Leaf Oil: Dried pimenta leaves, on steam distillation, yield 0 7-2.9% of an oil (Pimenta leaf oil) which, like berry oil, contains eugenol as its main component (65-96%) but has an inferior odour and flavour to that of the berry.

The leaves contain tannin and may be used locally for tanning purposes.

Pimenta bark and wood: The bark also contains tannin and a small quantity of an essential oil.

The wood from the tree trunk is of dark to light salmon colour with a very firm, hard, close texture and a smooth surface. It is inclined to warp unless in very narrow widths. The wood of the saplings is mainly used for making sticks, umbrella handles and card shafts. Thus, practically, every important part of the tree is economically utilised. The cultivation of such a spice which is claimed to be *four spices-in-one*, should be encouraged wherever technically feasible in India and elsewhere.

AMCHUR

Bot. Name : *Mangifera indica* Linn.
Family : *Anacardiaceae*

Indian names

Hindi: *Kachcha Am (Keri), Amchur;* Bengali: *Kachukacha Aam;* Gujarati: *Keri;* Kannada: *Mavina Kayi;* Malayalam: *Manga (Pacha);* Marathi: *Amba;* Oriya: *Kancha Ambu;* Punjabi: *Kachcha Aam; Amchur;* Tamil: *Mangai;* Telugu: *Mamidi Kayi;* Urdu: *Kachcha Aam, Amchur.*

Description and Distribution

Amchur is the dried or dehydrated product prepared from unr pe mango flesh in the form of peeled slices or powder used for acidification of curries etc. Mango is the most important fruit of India and is grown in many states of India. Invariably under-ripe and wind-fallen seedling or country mangoes are utilized for the manufacture of amchur. No particular varieties are in demand for this purpose. Generally, the cheapest immature raw fruits that are dropped by storms/winds are utilized for the preparation of amchur. Amchur is produced mostly in the northern states of India.

The unripe fruits are peeled and the flesh cut into thin slices. The slices are then dried in the sun and packed in gunny bags for sale. Amchur is also marketed in the form of powder by crushing or powdering the dried raw mango slices. Sometimes slices are seasoned with powdered turmeric and then sun-dried in order to avoid insect, pest attacks during preparation and storage. Recent statistics on production of amchur are not available. However, in 1950 and 1956, the following quantities of amchur are reported to have been manufactured in India when amchur was sold at 10-12 annas (60-72p) per lb.

	1950	1956	%Increase
Amchur (Maunds)	950,000	1,000,000	+5.3
Fruit used for the purpose (Maunds)	2,315,000	2,500,000	+8.0

Source : DMI, (1958), *Marketing of Mangoes in India*, Manager of Publications, Delhi.

Commercially, amchur is packed in jute bags. It is consumed mostly within the country and hence no export figures are available, nor on recent trends in amchur production and marketing. Amchur, when packed in air-tight bottles, can keep for a year or so.

Undoubtedly, mango is the most important national fruit of India, both in respect of acreage and production. 40% of the total area in India under mangoes is in U.P. alone This is followed by Bihar (11.4%), Andhra Pradesh (9.8%), West Bengal (9.5%), Orissa (8.8%) and Kerala (5.9%). It may be further interesting to note that in India about 63.1% of the total area under mango is under the seedling or country varieties of mango and about 35% of the area under mango in different states in India is under grafted varieties of mango. Amchur, in addition to use of the green mangoes in pickles, should provide an excellent outlet for the economic utilization of fallen marketable surplus green mangoes.

Composition

Analysis of a commercial sample of amchur showed the following composition - moisture: 14.7%; total acidity (as tartaric acid): 15.2%; reducing sugar: 3.0%; ash: 5.4%. The analysis of a typical sample of fresh raw mango revealed—moisture: 90%; protein: 0.7%; fat: 0.1%; carbohydrates: 8.8%; mineral matter: 0.4%; calcium: 0.01%; phosphorous: 0.08%; iron: 4.5mg/100g; carotene (vit. A): 150 IU/100g; vit. B_2 (riboflavin): 30mg/100g; vit. C: 8mg/100g; Calorific value: 39/100g. Amchur is rich in citric acid. Recently, a sample of amchur was found to be adulterated with added synthetic citric acid. No quality standards have yet been fixed for amchur by any standard-laying body.

Uses

Amchur is used as an acidulant or a 'souring agent' for curries, similar to the use of tamarind pulp extracts in the South Indian curries *sambhar* and *rasam*. It is also used in chutneys, soups and certain specific vegetable curries. The main purpose of its addition is to lower the pH of gravy whereby destruction of spoilage organisms in the vegetable curry, etc. is made much easier at boiling point.

It is further reported that unripe mango is useful in opthalmia and eruptions. The rind is astringent, stimulating tonic in debility of stomach.

The kernel, too, is an astringent, used in haemorrhage and diarrhoea and is anthelmintic; its juice, if snuffed, can stop nasal bleeding.

ANARDANA

Bot. Name: *Punica granatum* (L)
Family : *Punicaceae*

Indian names

Hindi/Hindustani: *Anardana;* Assamese: *Dalim;* Bengali: *Dalimb;* Gujarati: *Dalamb Dadam;* Kannada: *Dalimbari;* Kashmiri: *Daan;* Malayalam: *Mathalam Pazham;* Marathi: *Dalimb;* Oriya: *Dalimba;* Punjabi: *Anardana;* Sanskrit: *Dadima;* Tamil: *Mathalam Pazham;* Telugu: *Dannima Pandu;* Urdu: *Anardana.*

Description and Distribution

Anardana comprises the dried seeds (dried with flesh) of pomegranate fruit. Pomegranate is a shrub or a small tree 5-8 metres high, considered to be a native of Iran, Afghanistan and Baluchistan. It is found growing wild in the warm valleys and outer hills of the Himalayas between 900 and 1800m and is also cultivated at selected sites almost throughout India.

The pomegranate is an ancient and popular fruit. It is symbolic of plenty and prosperity. It grows best in the tropics below an elevation of 1000m with long, hot, dry summers and cool winters, or in those areas which are continuously warm and dry provided irrigation is available. High temperature should accompany the ripening season. The fruit is a large globose berry, shiny red, yellowish green, or whitish, when ripe, crowned by the calyx and is generally 5-7.5 cm in diameter. The fruit is filled with angular hard seeds which are covered with a juicy red, pink or yellowish white, sweet-astringent-acid pulp. It is these seeds with pulp, which, when sun-dried or dehydrated, constitute the condiment 'anardana'. Like amchur, anardana too is used as an acidulant in Indian curries in most of the northern states of India.

A wild type of pomegranate called 'Daru' grows abundantly in the lower Himalayas. Its seeds, when dried, give good quality anardana. Another source of anardana is said to be the wild pomegranate trees covering vast strips of hill slopes of Jammu and parts of Chamba, Kangra and Mandi districts of Himachal Pradesh and Punjab. The main areas where anardana is collected are the 'Raisu' Udhampur, Ramban, Kishtwar and Bhadurwah Forest Divisions. In these areas, the fruits are hand picked towards the middle of October, when they are ripe and brownish-red in colour. Seeds along with the pulp are separated by hand from the rind and are sun-dried for about 10-15 days when their colour turns reddish brown.

The main assembling centre for anardana is Udhampur from where distribution is done all over the country. About 350 tons of anardana are reported to have been marketed from Udhampur during 1963-64. More recent statistics of production of anardana are not available.

Composition

The analysis of the fresh edible portion (68%) of pomegranate (i.e. seeds with flesh) from Coonoor is as under – Moisture: 78.0%; protein: 1.6%; fat: 0.1%; fibre: 5.1%; other carbohydrates: 14.5%; mineral matter: 0.7%; calcium: 10mg/100g; magnesium: 12, oxalic acid: 14, phosphorus: 70, iron: 0.3,

sodium: 0.9; potassium: 133.0; copper: 0.2; sulphur: 12.0; chlorine: 2.0; vit. A (carotene): 0.0; vit. B_1 (thiamine): 0.006; vit. B_2 (riboflavin); 0 1; nicotinic acid: 0.30 and vit. C: 14mg/100g.

Uses

Anardana is mostly used as a condiment for acidification of chutneys and certain curries, as in the case of tamarind or amchur.

The seeds are reported to be stomachic while the pulp is both cardiac and stomachic. The rind of the fruit combined with cloves, etc. is useful in diarrhoea and dysentery. Seeds are also reported to have estrogenic activity as they contain steroidal estrogens.

Stem bark and root bark are astringent, anthelmintic and specific in tape-worms. They contain alkaloids.

ANGELICA

Bot. Name: *Angelica archangelica* Linnaeus.
Syn. : *Archangelica officinalis* Hoffmann.
Family : *Umbellifereae*
Other common names: American Angelica, Great Angelica, High Angelica, Purple Angelica and Master-wort, etc.

Description and Distribution

The fruit, young stem and roots of angelica plant are used for flavouring foods. Angelica is a stout and aromatic perennial herb, 1.5 to 3 metres high with small, pale yellowish-brown fruits, found in Kashmir. It is a native of Asia Minor and is cultivated in Germany, France, Belgium, Canada, and the USA. It possesses thick fleshy taproots with many rootlets attached. It develops a hollow, round, jointed, channelled, smooth, purplish stem, which is divided into numerous

branches. Greenish white flowers are borne in compound umbels. The whole plant is aromatic.

The taproots are short and thick, 5 to 10 cm long, and sometimes split. The numerous roots, frequently twisted or braided, possess a grey brown, reddish or purplish brown colour. They have a strong aromatic odour, and a warm, pungent, bitter-sweet taste. The seeds are oblong, round at the ends, and of whitish colour.

Volatile Oil: For distillation purposes, roots free from the lower woody stalk parts, which contain very little essential oil, should be preferred. The slender rootlets are particularly rich in oil. Upon prolonged ageing, the roots lose part of their essential oil, the yield decreasing as the more volatile terpenes gradually evaporate. Fresher roots yield oils of lighter colour having a more pronounced terpeny note; whereas oils distilled from old roots are darker, of higher specific gravity, and of lower optical rotation. These oils possess a characteristic musk-like odour, which is caused by the preponderance of oxygenated compounds—particularly lactones.

According to Gildemeister and Hoffmann, fresh angelica root, upon steam distillation, yields 0.10 to 0.37% of essential oil, dried root 0.35 to 1.00% and fruits 1.2 to 1.3%. According to Guenther, the yield of oil from normal dried root ranges from 0.40 to 0.50%; that from aged roots, is around 0.37%.

Distillation of angelica root should last at least ten hours. Prolonged distillation (upto twenty-four hours) yields oils of superior quality: they contain a relatively large amount of high boiling compounds. particularly lactones, which are the most important and characteristic constituents, so far as odour and flavour are concerned. According to Guenther, such oils possess a higher specific gravity, a higher ester number and a lower optical rotation than those described by Gildemeister and Hoffmann. The somewhat elevated acid number can be reduced by proper chemical treatment of the oil (by shaking the oil with a dilute aqueous solution of sodium carbonate)˙ The main constituent of the essential oil is β-phellandrene. The roots and fruits contain several furocoumarins such as agelicin, bergapten, xanthotoxin, etc., in addition to umbelliprenin and

some phenols. Besides, a new flavanone namely *archengelinone* has also been isolated from angelica.

Composition

Information on the chemical composition of angelica root, stem and fruits is not available, though data on essential oil analysis is available.

Uses

The stems, roots and fruits of the plant are used in the West for flavouring wines, liquors and confectionery.

The dry root, root-stalk and the fruits possess stimulant, expectorant and diaphoretic properties.

Use of angelica root and seed in pharmacy is probably a survival of those ancient beliefs which attributed medicinal properties to many aromatic herbs. The most important application of angelica roots and seed is in French-type alcoholic liquors and especially in gin absenthe, anesette, etc. In fact, next to juniper berries, angelica root is the main flavouring ingredient of gin. Instead of using root and seed, the flavour industry has recently shown preference for the essential oil, because it can be dosed more exactly.

The fresh stems and leaf stalks serve as a garnish and are also used for confectioneries. The flavour and perfume industry employ chiefly the root and seed, or their respective volatile oils, which can be recovered by steam distillation.

In Europe, angelica root and stem are candied and eaten as a conserve.

ANISEED

Bot Name : *Pimpinella anisum* Linn.
Synon. : *Anisum vulgare* Gaertner.
Anisum officinalis Moench.
Family : *Umbellifereae*

Hindi: *Imported* or *Valaiti Saunf* or *Aawonf*, *Badian;* Bengali: *Muhuri*, *Mitha jira;* Gujarati: *Anisi*, *Sowa*; Kannada: *Sompu;* Malayalam: *Shombu;* Marathi: *Somp*, *Badishep*; Oriya: *Sop;* Punjabi: *Valaiti Sounf;* Sanskrit: *Shetapusapa;* Tamil: *Chombu;* Telugu: *Kuppi Sopu.*

Description and Distribution

Aniseed is an annual herbaceous plant belonging to the Ajowan family and a native of the East Mediterranean region. It is widely cultivated in Bulgaria, Cyprus, France, Germany, Italy, Mexico, South America, Syria, Turkey and the U.S.S.R. In India, it is grown to a small extent as a culinary herb or as a garden plant. It appears that the reports of its cultivation and production are not correct since aniseed has often been confused with Fennel *(Foeniculum vulgare)* because of the common Indian name 'Saunf' applied to both. Even the commodity commonly available in the Indian market under the name of 'Lucknow Saunf' is called 'Indian Aniseed'. During 1967-68, aniseed worth Rs. 1.30 lakhs was imported from France, Spain and the UK, etc. It is only recently that some useful work has been done at the Indian Agricultural Research Institute, New Delhi, on the development of better varieties of aniseed imported from abroad. It is grown on a small scale in Rajasthan, Punjab, UP and Orissa. It can be successfully grown as a *rabi* crop.

In European countries too, aniseed is sometimes confused with another spice 'Star-Anise' (*Illicium verum*) which, of course, is botanically different. Aniseed bears fruits which contain volatile oil similar to that of star-anise. Therefore, they have almost similar odour and flavour. Of course, anise

oil is finer and has a more delicate flavour than that of star-anise oil.

Aniseed is ground-grey to greyish-brown in colour, 3.2 to 4.8 mm in length, oval in shape and with a short stalk (pedicel) attached. Five longitudinal ridges are visible on each pericarp. It has a characteristic agreeable odour and a pleasant aromatic taste. Aniseed is available whole or ground. Star-anise, though slightly cheaper than aniseed, is commercially more important than the latter on account of comparative price structure.

Composition

The chemical composition of aniseed varies with the origin of the fruits; the reported ranges of values are—moisture: 9-13%; protein: 18%; fatty oil: 8-23%; essential oil: 2-7%; sugars: 3.5%; starch: 5%; N-free extract: 22-28%; crude fibre: 12-25% and ash: 6-10%. Choline is also present.

Adulteration

Aniseed is adulterated with exhausted fruits, fine earth and other small seeds and fruits. Ground aniseed is sometimes found adulterated with ground fennel which resembles it in aroma and flavour and is considerably cheaper.

Anise oil is frequently adulterated with the lower-priced star anise oil. In India, probably the oil of fennel is sold as a substitute for true anise oil; the former can be distinguished by its lower anethole content and higher optical rotation (+11° to +20°). Other adulterants used are turpentine oil, cedarwood oil and capaiba and gurjun balsam oils. Adulteration with synthetic anethole made from pine oil is also reported.

Distillation of Oil

Aniseed, on steam distillation, yields an essential oil, known as 'Oil of Anise' which has now replaced the fruits for medicinal and flavouring purposes. Anise oil is a colourless or pale-yellow liquid having the characteristic odour and taste of the fruit.

The yield of oil generally varies from 1.9 to 3.1 per cent.

Higher values upto 6 per cent have been reported from Syrian aniseed. Crushing of fruits prior to distillation gives better yields of oil. The material should be distilled soon after crushing to prevent any loss of oil due to evaporation. Anise oil is a highly refractive liquid which solidifies on cooling. The congealing point depends much on the anethole content and is a valuable criterion for evaluating the oil. Exposure of the oil to air causes polymerization, and some oxidation also takes place with the formation of anisaldehyde and anisic acid.

The chief constituent of anise oil is anethole which is present to the extent of 80-90 per cent and is mainly responsible for the characteristic flavour of the oil. The oil also contains methyl chavicol, *p*-methoxyphenyl acetone, and small amounts of terpenes and sulphur-containing compounds of disagreeable odour. In addition, several minor compounds have also been identified in the Spanish oil.

Uses

Aniseed possesses a sweet, aromatic taste and emits, when crushed, a characteristic agreeable odour and is used for flavouring food, confectionery, bakery products, beverages, 'anisette' and other liquors. The fruit is considered mild expectorant, stimulating, carminative, diuretic and disphoretic and is used in flatulent colic, in the preparation of asthma powders and in veterinary medicine. Alcoholic extract of aniseed possesses fungicidal activity.

Essential oil is used in perfumery, soaps and other toilet articles and for flavouring culinary preparations, confectionery, beverages and liquor anisette. It is used in perfuming sachets, dental preparations and mouth washes; it is also used in the manufacture of liqueurs.

Oil of anise is also reported to be used as an aromatic carminative to relieve flatulence, and as an ingredient of cough-lozenges in combination with liquorice. It is a mild expectorant and is used as an antiseptic, and for the treatment of cholera. It may be used in the preparation of gripe water. The distillation 'water of anise' is sold in Indian

bazaars as 'Araq badian' or 'Araq saunf' and is reported to be used in medicine.

Essential oil is also used externally as an insecticide against small insects such as head-lice, mites and vermin. It also has fungicidal properties.

The residue left after extraction of oil may be used as a high-grade cattlefeed. It contains 17-19 per cent of protein and 16-22 per cent fat, in addition to carbohydrates.

Ether extraction of the exhausted fruits (freed of essential oil) yields a dark green fatty oil suitable for soap making. A hard fraction (yield 20%, m.p. 28.5-30.1°C) of the oil can be used as a substitute for cocoa butter in confectioneries and pharmaceutical preparations. The fatty oil expressed from the whole fruits possesses the characteristic anise flavour.

Fresh leaves of the plant are used as a garnish and for flavouring salads. They are eaten as pot-herb as they contain an essential oil and vitamin C (8.7 mg/100g.).

ASAFOETIDA

Bot. Name : *Ferula asafoetida* Linn.
Family : *Umbellifereae*

Hindi, Hindustani, Bengali, Gujarati, Marathi, Punjabi and Urdu: *Hing;* Kannada: *Hinger;* Kashmiri: *Yang*, *Sap;* Malayalam and Tamil: *Perungayam;* Oriya: *Hengu;* Sanskrit: *Badhika*, *Agudagandhu;* Telugu: *Inguva*, *Ingumo.*

Description and Distribution

Asafoetid or Asafoetida is the dried latex or oleogum oleoresin exuded from the living rhizome or rootstock or taproot of several species of Ferula, three of which grow in India, mainly in Kashmir. These are the perennial herbs belonging to the genus Ferula which are the sources of the oleogum resins used as condiment as well as in medicine. The species

are distributed from the Mediterranean region to Central Asia. The more important ferula oleogum resins imported into India, chiefly from Iran and Afghanistan, are (a) asafoetida, (b) galbanum and (c) sumbal. Of these, asafoetida is the most important. A part of the imported resin is re-exported from India to various countries. The trade name asafoetida is based on the scientific name of a related species, 'Ferula asafoetida'. Nearly a crore of rupees worth of asafoetida is being imported annually into India. The gross value of the sales, especially of the compounded asafoetida, as consumed in South India, is probably many times more. Surprisingly enough, very few of the consumers are aware of what substance it is, to what extent it is pure and whether it could be produced in India to the extent of our becoming at least self-sufficient.

The Ferula plants from which the asafoetida of commerce is extracted, have massive taproots or corrot-shaped roots, 12.5 to 15 cm in diameter at the crown when they are 4-5 years old. In March-April, just before the plants flower, the upper part of the living rhizome/root is laid bare and the stem cut off close to the crown. The exposed surface is covered by a dome shaped structure made of twigs and earth. A milky juice exudes from the cut surface. After some days, the exudate is scraped off and a fresh slice of the root cut when more latex exudes; sometimes the resin is removed along with the slice. The collection of the resin and the slicing of the root are repeated until exudation ceases (about 3 months after the first cut). The resin is sometimes collected from successive incisions made at the junction of the stem or rhizome and the taproots. With three incisions, some plants have been reported to yield about 1 kg or more of gum-resin.

Asafoetida is acrid and bitter in taste and emits a strong, disagreeable, pungent, alliaceous odour due to the presence of sulphur compounds therein. Hence its common name abroad, 'Devil's dung'.

Types/varieties of Asafoetida: Asafoetida of commerce is available in three forms, viz. 'tears', 'mass' and 'paste'. The 'tears' constituting the purest form of the resin, are rounded or flattened, 5-30 mm in diameter and greyish or dull yellow

in colour. The two types are recognised according to whether the tears retain the original pale colour for years or gradually become dark or reddish brown. Mass asafoetida is the common commercial form. It consists of tears agglutinated into a more or less uniform mass usually mixed with fragments of root, earth, etc. The paste form also contains extraneous matter.

There are several varieties of asafoetida which come under different classification and are priced accordingly. There are two major varieties of asafoetida, namely 'Hing' and 'Hingra'. 'Hingra' is said to be inferior to 'Hing' which is richer in odour and is the most fancied. Hing is further classified as 'Irani Hing' and 'Pathani Hing', according to their country of origin, the former being from Iran, and the latter from Afghanistan. Among them, again, there are several varieties. Of these, 'Hadda' is the most priced and the strongest. The two varieties of Irani asafoetida are 'Sweet' and 'Bitter' asafoetida. Sweet asafoetida is obtained from the horizontal cutting of the stem. Its colour is brown, is transparent or turbid, and contains pieces of stem. The bitter asafoetida is obtained from the cutting of the plant root. No pieces of wood exist. It is similar to amber coloured separated grains or a dough of white and red colour.

The two broadly recognised classes of asafoetida sold in the market with which most of the consumers may be familiar, are the white or pale variety and the dark or black variety. The former is water soluble and the latter is oil soluble. The question often asked is: What is the real difference between these two varieties? If one gets to know the chemical composition of asafoetida, there is not much difference. After all, asafoetida is an oleogum-resin; where the gum portion preponderates, as in Hing, it is water soluble, and where the resin portion preponderates, as in Hingra, it is oil soluble. Thus, depending upon the extent to which one component or the other preponderates, a sample of asafoetida is water-soluble or oil-soluble. The components to which asafoetida owes its characteristic odour, reside in the oil portion and are believed to be due to two classes of compounds. One of them is ferulic ester and the other—the more important one—is a volatile oil consisting of different sulphur compounds, some of which are similar to those

found in garlic and onion. Briefly, Hingra is the exudate of *Ferula foetida* Regel (*Syn: F. scorodosma*), while Hing is the exudate of *F. asafoetida* (Syn: *F. alliacea* Boiss). Irani Hing samples mostly contain woody residue but Pathani ones are comparatively free from wood. Specimens with a wet surface and agglutinated appearance occur in Pathani, but none in Irani. Hingra is heterogeneous in colour, consistency, etc.

Composition

Asafoetida contains resin, 40-64%; gum: about 25%; volatile oil, 10-17%; and ash, 1.5-10%. The resin portion consists chiefly of asaresinotennol, free or combined with ferulic acid. Umbelliferone seems to be present in the combined state.

According to the latest amendment of Food Adulteration Act, 1954 amended up to date, the definition for Hing or Hingra and Bandhani Hing is as under:

Asafoetida (Hing or Hingra) means the oleogum resin obtained from the rhizome and roots of *Ferula alliaces*, *Ferula rubricaulis* and other species of Ferula. It should not contain any colophony resin, galbonum resin, ammoniaccum resin or any other foreign resin.

Bandhani Hing or compounded asafoetida is composed of one or more varieties of asafoetida (*Irani or Pathani* Hing or both) and gum arabic, edible starches or edible cereal flour. It should not contain colophony resin, galbonum resin, ammoniaccum-resin or any other foreign resin, coal-tar dyes, and mineral pigment.

The comparative P.F.A. quality standards of Hing, Hingra and Bandhani Hing are tabulated below:

PFA Quality Specifications for Hing, Hingra and Bandhani Hing

Sl. No.	*Quality Attributes*	*Hing*	*Hingra*	*Bandhani Hing*
1.	Total Ash % w/w (Max.)	15.0	20.0	10.0
2.	Ash insoluble in dilute HCl% w/w (Max.)	2.5	8.0	1.5
3.	Alcoholic extract % (with 90% alcohol)	12.0 (Max.)	50.0 (Max.)	5.0 (Min)
4.	Starch % (Max.)	1.0	1.0	—

The quality and flavour of asafoetida are affected by a number of factors such as (i) part of the plant from which prepared (ii) the season of collection, (iii) the method of preparation, (iv) the degree of adulteration, and (v) the nature of adulterant used, etc.

Oil of Asafoetida

The oil of asafoetida is obtained by steam distillation of the gum-resin. Yield varies from 3 to 20%. The physico-chemical properties of the Bombay asafoetida are as follows—Sp. gr. at 20°C, 0.906-0.973; (a) Optical Rotation at 20°C, 9°0' to 9° 18; Refractive Index at 20°C, 1.493-1.518; and sulphur content, 15.3-29.0%. The chief constituent of the oil is secondary butylpropenyl disulphide; the remaining constituents are other disulphides, a trisulphide, pinene, another terpene, and an unidentified compound. The disagreeable odour of the oil is reported to be due mainly to the disulphide, ($C_{11}H_{20}S_2$). The oil has not attained any commercial importance. The flavouring and pharmaceutical industries employ chiefly alcoholic tinctures of the gum-resin.

Adulteration

Commercial asafoetida is grossly adulterated with gum arabic, other gum-resins, rosin gypsum, red clay, chalk, barley, or wheat-flour, slices of potatoes, etc. Different grades of asafoetida (Hingra, Hudda Hing, Hira Hing) varying in price are sold in the bazaar.

Uses

As flavourant: Asafoetida is extensively used in India for flavouring curries, sauces and pickles in conjunction with onion and garlic. In Iran (Persia), the natives rub asafoetida on warmed plates prior to placing meat on them. Besides, the large cabbage-like tops of the plants are relished raw by the natives.

In Medicine: Medicinally, it stimulates the intestinal and respiratory tracts and the nervous system. It is useful in asthma, whooping cough and chronic bronchitis. It is used as

an enema for intestinal flatulence. It is also administered in hysterical and epileptic affections and in cholera. Asafoetida is often employed in veterinary medicine. It is a very useful remedy for relieving spasms and in indigestion and colic. It is applied externally on the stomach to stimulate the intestines.

Recent studies have shown that (1) asafoetida oil has antibiotic properties and inhibits growth of microbes, (2) asafoetida has sedative properties and its possible use in heart disease has been suggested.

In the Ayurvedic system of medicine, the well-known recipe called *Hingashtaka* contains asafoetida as one of the important ingredients. However, the important question still remains as to whether such a reputation which asafoetida enjoys as a medicine is scientifically well-founded. If so, the precise mode of its action is yet to be understood clearly. Likewise, there is also need for rigorous implementation of purity standards as well as for the development of rapid and reliable analytical methods for the detection of adulteration. According to the Prevention of Food Adulteration Act (PFA), asafoetida (Hing or Hingra) shall not contain any colophony resin, galbonum resin, ammoniacum resin or any other resin, but it is generally felt that these standards do not fully reflect the true quality of asafoetida. The estimation of the odoriferous principles may be a truer measure of odour and hence the quality of asafoetida. There is need for intensification of researches in this direction. Further, knowing that there is considerable internal demand for asafoetida in India, particularly for medicinal and culinary purposes, there is need to encourage its cultivation in suitable areas in the inner Himalayas in order to be self-sufficient and thereby to avoid the heavy drain of valuable foreign exchange from India.

BALM OR LEMON BALM

Bot. Name : *Melissa officinalis* Linn.
Family : *Labiatae.*
Hindi: *Bililotan;* Urdu: *Baranjiboya.*

Description and Distribution

Balm or lemon balm is a perennial herbaceous plant of the Mint family, with a strong, agreeable odour, reminiscent of lemon and that is why it is also called lemon balm. It is evergreen, 30-60 cm in height and lasts for two years or longer. According to Guenther, it lasts for ten years but is normally maintained for four years. The blossoms are small and of white or light rose colour. The leaf or the herb is used as a spice and flavourant. A native of the countries bordering northern Mediterranean, it grows wild and is also cultivated in gardens as a medicinal herb. It has been naturalised in the USA, grows wild in the eastern USA and is found in the temperate Himalayas. Another plant *Melissa parviflora* Benth, which is considered a good substitute for *M. officinalis* (Lemon Balm), is an erect, pubescent or glabrate herb, 60-100 cm high, found in the temperate Himalayas from Garhwal to Sikkim, Darjeeling and Khasi, Aka and Mishmi hills, at an altitude of 1,200-3,000 m. Leaves are ovate or ovate-lanceolate, flowers white or pale pink, rarely yellow, in few or many-flowered auxiliary whorls; nutlets narrowly obovoid, dark, rugulose.

When the plants are in full flower, the crop is cut with a scythe or mower. If the flowering tops are to be marketed, the stemmy portions must be removed before or after drying. Drying is done in the shade in order to preserve the natural colour. The yield of the essential oil from the herb is low (0.014 to 0.01%) and hence its high cost of production.

Composition

Information on chemical composition of balm herb is not readily available though the composition of its oil has been

studied as briefly reported below: Specific gravity at 25°C: 0.8910; Optical rotation at 22°C: +2°8'; Refractive index at 22°C: 1.4704; Acid number: 2.2; Ester number: 27.42: Ester number after acetylation: 236.28; Aldehyde content (Bisulphite method): 42.0; Solubility in 0.5 vol. of 90% alcohol and in 2 vol. of 80% alcohol.

Uses

As Food Flavourant: Fresh or powdered balm leaves are used in fish dishes, stuffing or as a substitute for lemons. Fresh leaves are piquant in salads and in summer drinks. Thus balm leaves are widely used for culinary flavouring.

In Medicine: Leaves and flowering tops are also used in medicine. Lemon balm is said to possess stomachic, anti-tubercular and anti-pyretic properties; it is used to strengthen the gums and to remove bad taste from the mouth. The fruit is considered a brain tonic and is useful in hypochondriac conditions. Leaves and stems are also said to be useful in brain, liver and heart diseases and also in bites of venomous insects.

The volatile oil distilled from the plant is used for flavouring and also in perfumery. However, according to Guenther, this oil has not attained any commercial importance because of its excessively high price. It may, of course, be possible to simulate its odour by blending with other oils like those of lemon, lemon-grass, citronella, etc.

Oil of balm is reported to be sedative. Its properties in this regard resemble those of peppermint oil. Balm distillates can act as mild spasmolytic agents.

BASIL OR SWEET BASIL

Bot. Name : *Ocimum basilicum* Linn.
Family : *Labiatae.*

Hindi and Bengali: *Baburi Tulsi, Gulal Tulsi, Kali Tulsi, Marua;* Gujarati: *Damaro, Nasabo, Sabza;* Kannada: *Kama Kasturi, Sajjagida;* Kashmiri: *Niazbo;* Malayalam: *Tirunitnu;* Marathi: *Marva, Sabza;* Oriya: *Dhala Tulasi, Kapur Kanti;* Punjabi: *Furrunj Mushk Baburi or Niyazbo;* Sanskrit: *Munjariki, Surasa, Varvara;* Tamil: *Tirnirupachai, Karpura Tulasi;* Telugu: *Bhutulasi, Rudrajada, Vepudupachha.*

Description and Distribution

Basil or Sweet Basil, an erect glabrous herb, 30-90 cm high, native of North-West India and Persia, is an annual of the Mint family. In India, there is a widespread belief that if planted around homes and temples, it ensures happiness. It is indigenous to the lower hills of the Punjab and Himachal Pradesh and is cultivated throughout India. It is now cultivated in southern France and other Mediterranean countries and also in the USA. The freshly picked bright green leaves measure upto 3.75 cm in length. When dried, they turn brownish-green, whole and broken, brittle, curled or folded together. Dried leaves and tender four-sided stems of this plant are used as a spice for flavouring and for the recovery of essential oil. The flavour is warm, sweet and somewhat pungent and peculiar. The odour of sweet basil is aromatic, fragrant and sweet.

The leaves have numerous dot-like oil glands in which the aromatic volatile oil of the herb is contained. The herb bears clusters of small, white, two-lipped flowers in raceme fashion. It can be easily grown at home or in gardens in ordinary soil.

The plant is very variable and its botanical nomenclature is complicated; several designations have often been assigned to one or the same type. Polymorphism and cross-pollination

under cultivation have given rise to a number of sub-species, varieties and races, differing in height, habit of growth, degree of heaviness and colour of stems, leaves and flowers, and thus some forms and types have been confused with other species.

Varieties: There are numerous varieties of *O. basilicum* of which four are identified in India. They are *var. album* Benth (Lettuce-leaf basil), *var. differme* Benth (curly-leafed basil), *var. purfurascens* Benth (violet red basil), and *var. thyrsiflorum* Benth (common white basil). Curly-leafed basil is considered most suitable for cultivation; it is grown in France and is reported to give good yields of high quality oil.

Sweet basil possesses a clove-like scent with an aromatic, somewhat saline taste. It yields a volatile oil (Oil of Basil). The characteristics and composition of oil from different regions vary as briefly discussed below:

Types of Basil Oil: Four types of oil are recognised:

(i) **European Type,** distilled from *O. basilicum* grown in Europe and America and commonly known as oil of sweet basil; it contains methyl chavicol as the principal constituent and linalool, but no camphor; it is highly prized for its fine odours;

(ii) **Reunion Type,** distilled originally in Reunion Island, but now produced in Comorros, Malagassy (Madagascar) and Seychelles Island from plants of doubtful nomenclature; the oil contains methyl chavicol and camphor, but no linalool, it possesses a camphoraceous by-note and is considered inferior to the European oil;

(iii) **Methyl Cinnamate Type**, distilled in Bulgaria, Sicily, Egypt, India and Haiti; it contains methyl chavicol, linalool and a substantial amount of methyl cinnamate, but no camphor, and

(iv) **Eugenol Type,** distilled in Java, Seychelles, Samoa and the USSR. It contains eugenol as the main constituent.

Yield of Herb Oil: The flowers, on an average, yield 0.4 per cent oil while the whole plant (Indian basil) contains 0.10 to 0.25 per cent oil. By taking three harvests of the herb at two-month intervals, about 15 tons of herb per hectare can be had corresponding to 30 to 35 kg of oil. By taking the initial

three to four harvests of flowers (including main and sub-inflorescence) and final harvests of whole herb, about 3-4 tons of flowers and about 13 tons of whole herb can be had per hectare, corresponding to about 13 kg of the so-called flower oil and about 27 kg of whole herb oil; in all, 40 kg of oil per hectare is obtained. In case of labour shortage, three harvests of whole herb at an interval of one month after the first harvest give about 15 tons of herb corresponding to about 30 kg of oil. Oil of sweet basil, produced both from herb as well as flowers is saleable. In the long run, oil from whole herb is economical to produce.

Distillation of Oil: Oil of sweet basil is produced by the distillation of the herb. The flowers or/and whole herbs are packed into a distillation unit and hydro-distilled or steam-distilled. It takes, in all, about four hours to complete one charge. The oil, being lighter than water, is easily separated from oil-water mixture. It is advisable to use the distillate after removing oil for further charge as it contains a small quantity of oil. Oil yield is thus increased. Precaution should be taken that the distillation unit is clean and free from other odours, otherwise oil is likely to be contaminated with undesirable odours and colours. It is possible to produce oil worth about Rs. 10,000 from one hectare during June-November. The expenditure involved is about Rs 2,500 to Rs 3,000 per hectare.

Two grades of oil are produced, depending on the part of the plant used for harvesting. In Assam, Ganguli and his co-workers have shown that harvesting of plant should be done after the twelfth week and thereafter at intervals of two months. In all, three harvests become possible.

In the Tarai area, optimum yield of herb is obtained by taking the first four crops of flowers only (main and sub-inflorescence), and the last crop of the entire flowering herb. The first harvest is taken when the plants are in full bloom, second and subsequent harvests become available, thereafter every 15 to 20 days. Last harvest is taken of the entire plant and distilled. While harvesting the crop, precaution should

be taken that the root-system of the plant is not injured, otherwise yield of subsequent harvests will be affected adversely.

Composition

Basil contains protein, carbohydrates, volatile oil, fixed oil, cellulose, pigment, mineral matter and vitamins. According to analysis report of the American Spice Trade Association (ASTA), USA, the composition of Basil or Sweet Basil herb is as follows—mositure: 6.1%; protein: 11.9%; fat (Ether extract): 3.6%; fibre: 20.5%; carbohydrates: 41.2%; total ash: 16.7%; calcium: 2.1%; phosphorus: 0.47%; sodium: 0.04%; potassium: 3.7%; iron: 0.04%; vitamins (mg/100g)—vit. B_1 (thiamine): 0.15; niacin: 6.90; vit. B_2 (riboflavin): 0.32; vit. C (ascorbic acid): 61.3 and vit. A: 290 International units/100g. Calorific value (food energy): 325 calories per 100g of dried herb.

A good commercial sample of sweet basil has been found to contain volatile oil (min.): 0.4 per cent; total ash (max.): 15 per cent; acid insoluble ash (max.): 1 per cent; moisture (max.): 8 per cent; and total ether extract (min.): 4 per cent on moisture-free basis.

Quality of Oil: The oil obtained from flowers is better than the oil of whole herb in quality. Both oils are saleable and the yield and quality are comparable to those of the one produced abroad. A sample of oil distilled from plants grown in Chalakkudi (Kerala), had a fine lavender odour and was rich in linalool and methyl cinnamate. Another sample obtained from plants grown at the HB Technological Institute, Kanpur, contained methyl cinnamate, linalool, methyl chavicol and ocimene.

The quality of volatile oil varies greatly in composition and properties owing to differences in species, soil, climatic conditions and the part of the plant used, etc. The European oil, known to be true to name, shows according to results of several authors—Sp. gr. at 15°C: 0.895-0.930; Refractive index: 1.477-1.495; Optical rotation: —22° to —6°; Ester number: 3-15; Acid number: 0-4 and soluble in 1-2 parts of 80 per cent alcohol. Alcohol content, calculated as linalool: 34.50 to 39.66%. The methyl chavicol content of all these oils was

about 55 per cent, calculated by determining the methoxy number according to Zeisel's method.

Methyl chavicol, the main constituent of sweet basil oil, is oxidized on ageing and exposure of the oil to light and air; thus older oils usually show a higher specific gravity and a higher refractive index. Sweet basil oil must, therefore, be stored carefully.

Adulteration of Sweet Basil Oil: This oil is frequently adulterated with the much lower priced Reunion basil oil. Such an addition is indicated by increased specific gravity and refractive index and by a lowered levo-rotation, or slight dextrorotation, depending upon the amount of Reunion oil present. These discrepancies can be partly corrected by the addition of l-linalool; therefore, adulteration of sweet basil oil is not always detected by mere routine analysis. The expert will submit the oil to a careful organoleptic test, watching especially for the presence of camphor which does not occur in true sweet basil oil.

Uses

As Food Flavourant: Sweet basil is used in soups, meat pies, fish, certain cheeses tomato cocktail, eggplant, zucchini, cooked cucumber dishes, cooked peas, squash and string beans; chopped basil is sprinkled over lamb chops before cooking. Basil is often used with, or as a substitute for, oregano in pizza topping, spaghetti sauce or macaroni and cheese casserole. It is also used in the manufacture of chartreuse and other liqueurs. Sweet basil from Italy and America is known for its quality. In Italy, basil is an important seasoning in tomato paste products. In France, it is known as the *Herberoyaale*.

Although not used in large quantities, the oil of sweet basil is employed quite extensively in all kinds of flavours, including those for confectionery, baked goods and condimentary products (chilli sauces, catsups, tomato pastes, pickles, fancy vinegars) and in spiced meats, sausages, etc. The oil serves also for imparting distinction to flavours in certain dental and oral products.

In Perfumery and Cosmetics: Sweet basil oil has its place in certain perfume compounds. For the scenting of soaps, the lower priced Reunion oil is preferable. Reunion basil oil is employed in all cases where the high price of the true sweet basil oil makes the use of the latter prohibitive.

In Medicine: The plant is considered stomachic, anthelmintic, alexipharmic, antipyretic, diaphoretic, expectorant, carminative, stimulant and pectoral. An infusion of the plant is given for cephalalgia and gouty joints, and used as a gargle for foul breath. The juice of the leaves is considered useful in the treatment of croup and is a common remedy for coughs. It has a slightly narcotic effect and allays irritation in the throat. It is used as a nasal douche and as a nostrum for earache and also for ringworm. The plant is used in homeopathic medicine.

Roots, bark and leaves are cyanogenetic. Alcoholic extracts of leaves and alcoholic and aqueous extracts of flowers possess anti-bacterial activity against *Micrococcus pyogenes* var. *aureus*. Seeds possess demulcent, stimulant, diuretic, diaphoretic and cooling properties. They are given internally in cases of habitual constipation and piles. They are used in poultices for sores and sinuses. Leaves are useful in treatment of croup, for which warm juice with honey is given. Root is used in bowel complaints of children. Flowers are carminative, diuretic, stimulants and demuls.

As Insecticide, Insect-Repellent and Bactericidal: Basil oil possesses insecticidal and insect repellent properties. It is effective against house-flies and mosquitoes. It is also bactericidal. The Rideal Walker co-efficient against *Salmonella typhoxi* is 12.

Use of Basil Seeds: The seeds of the plant are odourless with an oily, slightly pungent taste. When steeped in water, they liberate a mucilage which is semi-transparent and nearly tasteless. The mucilage (9.3%) yields, on hydrolysis, uronic acid, glucose, xylose and rhamnose.

The seeds contain a drying oil with the following fatty acid composition: palmitic 7.0; stearic 0.2; oleic 11.0; linoleic 60.0.

and linolenic acid 21%. The unsaponifiable fraction is reported to contain β-sitosterol, oleonolic acid and ursolic acid.

Aqueous extracts of seeds are active against gram-positive bacteria and mycobacteria. Alcoholic extracts inhibit the coagulase activity of *Micrococcus pyogenes* var. *aureus*. Seeds are also given in infusion in gonorrhea, dysentery and chronic diarrhoea.

BAY or LAUREL LEAVES

Bot. Name: *Laurus nobilis* Linn.
Family : *Lauraceae.*
Indian Names: No information available.
Other common English Names: Sweet Bay or True Laurel.

Description and Distribution

Laurel leaves or bay leaves are the dried leaves of *Laurus nobilis* L. They grow in the Mediterranean countries and are cultivated in Greece, Spain, Portugal, Asia Minor and Central America. It is sometimes grown in Indian gardens but does not seem to thrive well. The surface colour of the leaf is green; the underside is pale green and somewhat yellowish. Laurel leaves are used whole or cracked. The aroma of the crushed leaves is delicate and fragrant. The taste is aromatic and bitter.

They should not be confused with the leaves of Bay rum tree (*Pimenta racemosa* Mill., family *Myrtaceae*) from Puerto Rico and nearby islands, or with the California 'Bay laurel' (*Umbellularia california* Nutt., family *Lauraceae*). The 'Sweet Bay' or 'Laurel' leaves originate from an evergreen hardy tree or bush cultivated since antiquity in Mediterranean countries. Size of leaves is variable, ranging from 2.5 to 7.5 cm or more in length and 1.6 cm to 2.5 cm or more in breadth

at the widest part of the leaf. The shape of leaf is elliptical, tapering to a point at base and tip of leaf.

Dried berries of the tree, commonly called 'bay berries' have been imported into India for medicinal use. The berry is ovoid (about 1.5 cm long), black, coarsely wrinkled and contains a single seed.

The leaves, on steam distillation, yield 1-3% essential oil with a characteristic sweet and spicy odour, reminiscent of cajuput. According to another report, fresh leaves and branchlets yield 0.5% oil, while dried leaves yield about 0.8%.

Composition

According to ASTA, the chemical composition of dried bay leaves is as follows—moisture: 4.5%; protein: 7.6%; fat: 8.8%; fibre: 25.2%; carbohydrates: 50.2%; total ash: 3.7%; calcium: 1.0%; phosphorus: 0.11%; sodium: 0.02%; potassium: 0.6%; iron: 0.53%; vitamins (mg/100g): vit. B_1 (thiamine): 0.10%; vit. B_2 (riboflavin): 0.42; niacin: 2.0; vit. C (ascorbic acid) 46.6 and vit. A: 545 International units (I.U.), Calorific value (food energy): 410 calories/100g.

Analysis of the leaf made at the Muster Experiment Station, Berlin, showed: moisture 9.45%; protein 8.34%; fixed oil 4.49%; volatile oil 3.63%; alcohol extract 25.01%; nitrogen free extract 38.33%; fibre 31.83%; and ash 4.53% in the Italian variety. The dry bay leaves also contain 13.84% of pentosans.

Volatile Oil: According to Parry, laurel leaves yield 1 to 3% of volatile oil having the following properties—Sp. gr. at 15°C: 0.915-0.930 (occasionally higher); Optical rotation at 20°C: —15° to —22°; Refractive index at 20°C: 1.4670-1.4775; Principal constituent: Cineol, 25-50%. Solubility: 1 part in 3 parts of 80% alcohol. Its principal constituent (upto 50%) is cineol, a colourless liquid with a strong, aromatic, camphoraceous odour, and a cooling taste. Other organic compounds include α-pinene, α-phellandrene, l-linalool, l-β-terpineol, geraniol, eugenol, eugenol acetate, methyl eugenol, a number of esters and acetic, isobutyric and isovaleric acid.

Uses

Bay leaves are among the world's oldest herbs. Wreaths of laurel leaves were used by the Greeks and Romans to honour their heroes. Laurel leaves are used principally in vinegar pickle when packing pig's feet and lamb and pork tongue. They are also used in flavouring of soups, stews, meat and game dishes, fish and sauces, pickling, spice, etc.

In Medicine: Both leaves and fruits possess aromatic, stimulant and narcotic properties and were formerly employed for hysteria, amenorrhoea and flatulent colic. They are even used internally, though rarely at the present time. Externally, however, commercial oil of laurel berry is sometimes applied as a stimulant in sprains, but its principal use is in veterinary medicine. The leaves are employed as a condiment and flavouring agent in foods and confectionery. The culinary uses are numerous as mentioned above. Laurel leaves are available whole or cracked, are not usually ground, and are packed in bags of 55 lb and 110 lb capacity.

The berry (pericarp, 30%, seed, 70%) yields 20-34% of an aromatic fat used to some extent in pharmacy, veterinary practice and perfumery. Commercial fat is obtained from the whole berry by pressing or by boiling with water and skimming off the separated fat. The fat (m.p. 30-34°) is green in colour and has the following characteristics—Sp. gr. 20C°: 0.921-0.941; Refractive index: 1.460-1.465; Acid value : 5-34; Sap. value: 188-216; Iodine value: 75-99; Thiocyanogen value: 55.8; R.M. value: 1.5-3.2; Polenske value: 2.8; and Unsaponifiable matter (phytosterol, melissyl alcohol, a hydrocarbon and an unsaturated oily substance): 1-6%. The mixed fatty acids contain lauric, 30.35%; palmitic, 10-11%; oleic, 33-40%; and linoleic, 18-32%.

Berries are used in diarrhoea, buer and dropsy. In Europe, they are also used to promote miscarriage.

Fresh terminal branchlets and leaves, on steam distillation, yield 0.5% of a volatile oil with a characteristic sweet and spicy odour, somewhat suggestive of cajuput oil.

Laurel wood resembles walnut wood in grain and colour and is suitable for decorative cabinet work, etc.

CAPER

Bot. Name : *Capparis spinosa* Linn.
Family : *Capparidaceae.*

Hindi: *Kabra;* Kannada: *Mullukattari;* Marathi: *Kabar;* Punjabi: *Kaur, Barar;* Telugu: *Kokilakshamu.*

Description and Distribution

Capers are the buds of the unexpanded flowers of *Capparis spinosa* L., a low trailing or prostrate bushy shrub with close heavy foliage, growing in the south of Europe, North Africa and in India in the low inner valleys of Himalayas, Chamba, Kumaon, Maharashtra, Konkan, Andhra Pradesh (Deccan Peninsula), Western Ghats, the Punjab, Rajasthan and north-western India.

A spiny shrub of straggling habit, a little less than a metre high, it is valued chiefly for its flower buds which are picked and sold as 'Capers'. It may be grown as a green-house plant in colder areas and outdoors in warmer parts. It is deciduous with roundish leaves. The most conspicuous feature of the fleeting white flowers is the mass of purple-tipped stamens.

The tiny buds open when the sun rises and close when it sets. Once cut, they remain closed. The capers are graded on copper sieves, and the smaller the bud the higher the grade. Usually, they are cured and prepared in salt. The bitter salty taste is epicurean, and very few capers are necessary to give the added flavour sought for.

Commercial European capers are the pickled flower buds of *C. spinosa*. They have an acrid, burning taste, and are considered useful in scurvy. In India, the buds, and also the fruits, are similarly used.

Composition

Flower-buds contain a glycoside, rutin, (m.p. 188°C), which, on acid hydrolysis, gives rhamnose, dextrose and quercetin. On hydrolysis, by the enzyme rutinase, it yields the sugar rutinose and quercetin. The former, on acid hydrolysis, gives

rhamnose and dextrose. Flower buds contain about 4% pentosans on dry wt. basis. They also contain rutic acid, pectic acid, a substance with garlic odour, a volatile emetic constituent and saponin.

Caper seeds yield 34-36% of a pale yellow oil. The component acids of the oil are: palmitic and stearic, 7-9%; oleic, 42-46%; and linoleic, 45-51%; acid value, 7.1-44.1; and iodine value, 115-125.

The root bark contains rutic acid and a volatile substance with garlic odour.

Uses

Capers are used most expertly by many European and American cooks. Fish and meat sauces are especially delicious with a few capers added; and as a garnish for cold roasts and salads, capers are unequalled in flavour. Besides, capers are also used for flavouring pickles and relishes; caper sauce with boiled mutton is a great favourite in Western countries.

In Medicine: In India, caper buds as well as the fruits are considered useful in scurvy. Leaves (bruised) are used as a poultice in gout. The leaves and ripe fruits are relished by goats and sheep. Leaves contain—moisture, 69.6%; protein, 13.8%; other extract, 1.5%; crude fibre, 7.9%; N-free extract, 53.7%; insoluble ash and soluble ash, 17.7%.

The bark is bitter, aperient, diuretic, expectorant, emmenagogue and tonic. It is used in rheumatism, paralysis, toothache, affections of liver and spleen, and tubercular glands.

CAPSICUMS OR CHILLIES

Bot. Name	:	*Capsicum annum* Linn.
Bird Chilli	:	*Capsicum fruitescens* Linn.
Tabasco Chilli	:	,, ,,
Family	:	*Solanaceae.*

Hindi, Punjabi, Urdu: *Lal Mirch;* Bengali: *Lanka, Lanka-Morich;* Gujarati: *Marcha;* Kannada: *Menssina Kayi;* Kashmiri: *Martsu, Waungum;* Malayalam: *Mulaku*; Marathi: *Mirchi;* Oriya: *Lanka;* Tamil: *Milagai*; Telugu: *Mirapakayi.*

(i) CHILLIES

Description and Distribution

Chillies are the dried ripe fruits of the species of genus capsicum. They are also called red peppers or capsicums and they constitute an important, well-known commercial crop used both as a condiment or culinary supplement and as a vegetable. It is virtually an indispensable item in the kitchen. Among the spices consumed per head in India, dried chilli contributes the major share. *C. annum* is a variable annual sub-shrub (originated in the American tropics) to which the flowers are born singly and the fruits are usually pendent, which provide us all the red peppers, cayenne, paprika and chillies, while a mild form with large inflated fruits constitutes the sweet pepper and is used as vegetable. Red peppers or chillies are cultivated mainly in tropical and sub-tropical countries, notably Africa, India, Japan, Mexico, Turkey and the USA, etc.

Almost all the varieties of low and medium pungency that are cultivated on field scale in India belong to *Capsicum annum* species. It is only the few perennial chilli varieties which are characterised by the small size of the pod and high pungency which are rarely cultivated on field scale (such as Bird chilli and Tabasco chilli) and belong to the other species *Capsicum fruitescens.* Chilli was not known to Indians about 400 years ago, since this crop was first introduced into India

by the Portuguese towards the end of the 15th century. Its cultivation became popular in the 17th century. Chilli is actually reported to be native to South America and its cultivation was known to the natives of Peru since prehistoric times.

Chillies are grown practically all over India. In India chillies occupy about 8,14,000 hectares with a production of 8 lakh tons (Annexure IIA.) Four States, namely, Andhra Pradesh, Maharashtra, Karnataka, and Tamil Nadu alone account for about 75% of the total area as well as production (Annexure II). The other States, growing chillies commercially are Madhya Pradesh, Punjab and Bihar. The highest yield is in Jammu & Kashmir, Tamil Nadu, Delhi, West Bengal, Punjab and Bihar. Hardly 2.5 to 3.0% of the total produce is being exported, earning foreign exchange to the tune of about Rs. 18-20 crores annually. (Annexure I) Till recently, about 90-95% of total exports of chillies (mostly of Sanam variety of Tamil Nadu) was to Sri Lanka alone, but because of the recent total ban on the import of chillies into Sri Lanka, India is exploring the possibility of diverting chilli exports to other sophisticated markets in the world. The possibilities of exports to the Middle East countries including the Gulf States remain to be explored on priority. Development and export of paprika type peppers to European countries provides another opening for Indian chillies.

Varieties: Commercially, chillies may be classified on the basis of their colour, size, pungency and the end use to which they are put. According to B. Choudhuri, only four species, are under cultivation in different parts of the world. However, out of these, the cultivation of two species, viz. *C. pendulam* and *C. pubescent* is mostly restricted to South and Central America. The other two species, viz. *C. annum* and *C. fruitescens* are commercially cultivated practically throughout the world. *C. annum* is the most commonly cultivated species and most of the chillies grown in India belong to this species.

Many varieties of chillies have been recorded in India, varying in shape, colour, size and pungency of fruits. As such, there appears to be scope for the selection and breeding

of species suiled to the hot wet tropics and different climates in India. Recently, successful attempts have been made at the IARI, New Delhi, to obtain induced chilli mutants containing high pungency capsaicin content but low carotenoid pigments and are high yielding. This will facilitate the extraction of capsaicin from such yellow or cream coloured chillies since otherwise red pigments do interfere and delay its extraction.

The varieties of chillies are broadly divided into two groups as follows : (*i*) The long pungent type, including the pickling type, used as a spice, and (*ii*) the bell-shaped, non-pungent or mild, and thick-fleshed type, popularly known as 'Simla Mirch' which is commonly used as a curried vegetable.

'Paprika' also belongs to the mild group (*C. annum*).

The varieties vary in colour from red to yellow or white, in shape, from long and thin to round or oblong, and in size from 1 cm to as much as 30 cm in length. Good fruit length, shining red colour, high pungency and strong attachment of calyx are the important quality factors which determine the price of chillies. Commercially, there are various grades such as 'First sort', 'Second sort', mixtures, etc. or alternatively as 'special' 'medium' and 'fair' grades as prescribed under Agmark.

(ii) PAPRIKA (*C. annum*)

Paprika or Hungarian Paprika, also called sweet pepper, *Spanish pimiento*, is the mild or non-pungent variety of chilli or capsicum. The dried ripe red paprikas are valued chiefly for their brilliant red colour and mild flavour. The European paprikas are different from their cousin red chillies which are grown extensively in India. Today, there is considerable demand for paprika powder in the Western world. It is desirable to extend area under paprika in India with the ultimate object of diversification of exports, particularly when the gates of Sri Lanka are closed to all countries including India for the import of chillies into Sri Lanka. Some success has already been attained both at the IARI, New Delhi, and CFTRI, Mysore, where several varieties of paprika have been successfuly grown, indicating good scope for expansion of area under paprika.

It is reported that it was during a Turkish invasion of Hungary in the 16th century that a new crop was introduced to the land of the Magyars. They called it "Turkish pepper", which in the Hungarian language became paprika. In reality, paprika was not Turkish at all. It was a product of the New World—a member of the huge plant family of pod peppers called *Capsicums*—a native to the Western Hemisphere. Turkey had simply been one of the many places which received seeds of capsicum plants soon after the discovery of the Americas. Yet, paprika, as it developed in Europe, became a very special spice which was quite different from its relatives across the Atlantic. In Europe, under different soils and climates and due to cross breeding, the fruit of these capsicums took on new characteristics. In Hungary, the traditional peppers became much milder than their American cousins, but they still retained a distinctive nip. But, regardless of whether the European peppers had little or no bite, they all eventually became known as paprika. Even the Spaniards, who had originally named their product *pimenton*, were forced to use the term paprika when they entered the export market; such was the acceptance and popularity which the Hungarians had built for this spice.

In recent years, the paprika story has taken an interesting new turn. Increasing quantities are now being produced in the hemisphere of its ancestors. In California, there is a thriving paprika industry which has developed both sweet and mildly pungent types. In India about 15 varieties of paprika have been successfully grown at the IARI, New Delhi, and also in the orchards of Central Food Technological Research Institute (CFTRI), Mysore.

Since several varieties of *Capsicum annuum* L. are used to produce paprika, pods in one growing area may differ in shape and appearance of those from another. Some have a fairly round shape with a pointed end; others are elongated. In general, they are medium to small, as peppers go, and quite fleshy. They grow on small, bushy plants. When ripe, they are picked and either spread out to dry naturally or dehydrated in specially constructed tunnels, depending on the producing area. It is a unique fact in the spice realm that paprika *always* refers to a ground product. It is processed into

powder where it is grown, whether overseas or domestically. In most cases, other spices are shipped from the sources in the whole form.

Paprika peppers are selectively bred for colour and flavour. These factors can be further controlled to a certain extent by the processing which the harvested pods are given. The seeds and veins have negligible red colour; therefore, the more of these materials the processor removes, the more intense will be the red colour of the ground product. Removal of vein material also may affect pungency, since whatever pungency is present in paprika pods is found in the veins or placenta.

One of paprika's extremely interesting attributes is its content of vitamin C (ascorbic acid). The Hungarian scientist, Dr Szent-Gyorgyi, who won a Nobel Prize in 1937 for his work on vitamin C, found paprika pods to be one of the richest sources of ascorbic acid.

What is good Paprika ? Paprika is used for its colouring and flavouring properties. The end use determines which of these factors is most important and, therefore, which paprika is best for a particular buyer. In general, a high 'colour extraction rating' enhances the value of paprika, but in many cases, this can also be the most economical product to use, since less may be needed. The term 'colour extraction rating' (amount of colour extracted by an appropriate solvent) is emphasized because surface colour is not always a reliable indication of paprika's colouring properties. Occasionally, a paprika which looks richly red to the naked eye, will deliver less colour than expected in a finished food product. This is because the surface colour can vary with fineness of grind, amount of heat (temperature) developed during processing and the moisture content. Storage temperatures and humidity (as well as the raw material itself) at the time of grinding may also affect this outward appearance. This is not to say, however, that surface colour should not be considered; it should be considered, along with fineness of grind and the colour extraction value.

In the home and public eating places, paprika is used largely as a garnish for light coloured foods, such as eggs, poultry, fish, potatoes, pasta, salads and salad dressings. In food

manufacturing, flavour is important, as this spice becomes a vital ingredient of sausages, soups, salad dressings and many ready prepared foods.

Major Types of Paprika: According to the American Spice Trade Association (ASTA), the following 6 major types of paprika exist in the world market. They are:

(1) **American Paprika**—This paprika is grown and produced in southern California. In recent years, California has become a larger supplier of paprika than any other individual country. Both sweet and mildly pungent types are grown in this State. The American Paprika is scientifically and mechanically dried, making it possible to adjust moisture for maximum stability and retention of maximum colour extraction value. American producers were among the first to standardise colour and shape uniformly throughout the year.

(2) **Bulgarian Paprika**—Bulgaria is the one East European source that produces predominantly mild paprika. It has gradually increased its production, much of which is used within Europe, but its share with the USA market has broadened. It is used mainly for food manufacturing purposes. Bulgaria also produces pungent paprika, although in a limited quantity.

(3) **Hungarian Paprika**—Historically, Hungary was the second largest supplier of paprika to the USA, but in the past few years, the bulk of their crop has been sold in Europe itself. Hungarian Paprika has a distinctive flavour and is in great demand in Europe, where it is used as a spice rather than a colouring agent. In recent years, Hungary has also produced sweet paprika to suit the requirements of US buyers. Both 'free-flowing' and regular grinds are shipped for all types of Hungarian Paprika.

(4) **Moroccan Paprika**—This is similar to Spanish Paprika, since its industry is based on Spanish traditions. Morocco produces medium and high colour paprika according to demand, but it is less flexible than Spain in filling small orders because its production is concentrated in a smaller number of larger mills. Morocco can also produce a mildly pungent paprika.

(5) **Spanish Paprika**—Over the years, Spain has supplied the

bulk of the paprika used in the USA. Spain produces a sweet paprika in a wide range of colour values. The Spanish Government sets up minimum standards for each crop, dividing it into grades (1 to 6; No. 1 being very high in colour and each successive grade somewhat lower). Individual producers generally have brand names for the various qualities they market. Spanish Paprika can be ground to the customer's specification, but a medium grind, known as 'free-flowing', is normally shipped. Other grinds require special order.

(6) **Yugoslavian Paprika**—This type is quite similar to the Hungarian variety. It is normally ground fine and contains slight heat or pungency. However, Yugoslavia is now concentrating on keeping the pungency factor to a minimum in its paprika called "Capsaicin Free". Yugoslavian Paprika has good colour value and is primarily used for food manufacturing purposes.

Other Paprikas—Paprika from Czechoslovakia and Chile (both sweet to mildly pungent), Rumania, Turkey and Greece (mildly pungent to hot), Portugal (sweet, medium high in colour) also are exported. India should enter the world market and diversify its exports in chillies paprika by bringing in more area under paprika.

Chillies should be stored in a cool, dry and dark place, as exposure to light, high temperature and oxygen bleaches or decomposes their colour for which they are valued the world over. The red colour is due to the presence of a number of carotenoid pigments, notable among them being *capsanthin* and *capsorubin*.

(iii) BIRD CHILLIES AND TABASCO CHILLIES
(*C. frutescens* Linn.)

Bird chilli is a shrubby perennial plant, 0.9 to 1.2 metres high, bearing small conical fruits, 12-25 mm long which are extremely pungent. It occurs wild or semi-wild in the tropics. The plants degenerate under cultivation in one or two years. *C. frutescens* with small highly pungent and erect fruits is a comparatively short-lived perennial, in which two or more flowers are produced at each node; it yields bird chillies and

tabasco. The two species do not cross readily and the F_1 hybrids are highly sterile.

The ripe fruits of these species are dried in the sun or in a mechanical drier. They are then powdered to the desired mesh as in chillies or peppers. They are sold whole or ground.

The pungent principle in chillies is an alkaliod called capsaicin. The capsaicin content varies from zero in sweet or bell peppers to 1.8% in bird chillies, tabasco and other hot chillies.

Cayenne pepper is made from finely ground dried bird chilli mixed with salt (25%).

Composition

The composition of chillies and paprika is as under:

Physico-chemical Characteristics	*Indian green chilli*	*Indian red chilli (dry)*	*Indian paprika (dried)*	*American pepper/ chilli*	*American red pepper*
Moisture%	82.60	10.00	7.90	6.50	6.20
Protein%	2.90	15.90	13.80	14.00	16.00
Fat%	0.60	6.20	10.40	14.10	15.50
Fibre%	6.80	30.20	19.20	15.60	26.00
Carbohydrates%	6.10	31.60	41.10	42,60	28.30
Total ash%	1.00	6.10	7.60	7.20	8.00
Calcium%	0.03	0.16	0.20	0.10	0.10
Phosphorus%	0.08	0.37	0.30	0.32	0.32
Iron%	1.20	2.30	0.23	0.01	0.01
Sodium%	—	—	0.02	0.01	0.01
Potassium%	—	—	2.40	2.10	2.10
Thiamine mg/100g.	—	—	0.60	0.59	0.52
Riboflavin mg/100g.	1.18	—	1.36	1.66	0.93
Niacin ,,	0 50	—	15.3	14.20	13.60
Ascorbic acid ,,	111.00	50	58.80	63.70	29.41
Vitamin A (I.U./100g)	54	576	4915	6165	3530
Calorific value (cal/100g.)	41	246	390	415	420

Uses

As Food Flavourant : Dry chilli is extensively used as a spice in all types of curried dishes in India and abroad. Curry powder

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is made by grinding roasted dry chilli with other condiments such as coriander, cumin, turmeric and farinaceous matter, etc. It is also used for seasoning of egg, fish and meat preparations, sauces, chutneys, pickles, frankfurters, sausages, etc.

Bird chilli is used in making hot sauces such as chilli sauce and tabasco sauce. 'Mandram' is a West Indies stomachic preparation made by adding cucumber, shallot, lime juice and Madeira wine to mashed fruits of bird chilli.

Paprika as Colourant and Flavourant: Paprika, Red Pepper, Kashmiri Mirch or Degchi Mirch which are mild in pungency, are used to colour, flavour and garnish dishes, and Simla Mirch, which is not pungent and is used as curried vegetable, is specially rich in vitamin C. One Simla Mirch a day fulfils our daily requirements of vitamin C. It is necessary that its use must be encouraged and popularised. Use of attractive red paprika in tomato ketchup and sauces should also be encouraged for improving their colour since addition of synthetic colour is no longer allowed in tomato ketchup under the latest food laws of the country.

Role in Human Physiology: Chillies, when taken with food, stimulate our taste buds and thereby increase the flow of saliva which contains the enzyme 'amylase' which, in turn, helps in the digestion of starchy or cereal foods, etc. into the easily assimilable sugar, namely glucose.

When eaten fresh with salads, they, being rich in vitamins C and A, serve as a good vitamin supplement in addition to their being an appetizer. Thus, green chillies are more nutritious than ripe, dried chillies or chilli powder, as most of the vitamins are lost during drying.

Medicinal Properties: Capsicum preparations are used as counter-irritants in lumbago, neuralgia and rheumatic disorders. Taken internally, capsicum has a tonic and carminative action and is specially useful in atonic dyspepsia. It is, however, contra-indicated in gastric catarrh. Taken inordinately, it may cause gastro-enteritis. It is sometimes added to tannin or rose gargles for pharyngitis and sore throat. It is administered in the form of powder, tincture, linament, plaster, ointment, medicated wool, etc. In some of these preparations,

oleoresina capsici B.P.C., syn. Capsaicin, the alcohol soluble fraction of the ether extract of capsicum, is the active ingredient. Pharmacopoeial requirements are chiefly met by the highly pungent varieties of capsicum (*C. frutescens)* grown in Sierra Leone, Nyasaland and Zanzibar. Indian capsicum, known in trade as 'Bombay capsicum' is used as a substitute.

According to the latest researches conducted at Cancer Research Institute, Adyar, Madras, green chillies are reported to retard cancer.

CARAWAY

Bot. Name: *Carum carvi* Linn.
Syn : (1) *Apium carvi* (L) Crantz.
(2) *Seseli carvi* (L) Lam *et* Dc.
Family : *Umbellifereae.*

Hindi: *Shia Jira* or *Siya Zira*; Bengali: *Jira* or *Zira*, Kannada: *Shime Jeerige*; Kashmiri: *Gunyun*; Malayalam: *Shima Jirakam*; Marathi: *Wilayati Zirah*; Punjabi: *Zira-siah*; Sanskrit: *Sushavi*; Sindhi: *Kalu duru*; Tamil: *Shimai Shembu*; Telugu: *Sima Jirakaia.*

Description and Distribution

Caraway, or 'Caraway seed' of commerce, is the fruit of a biennial herb known botanically as *Carum carvi*, Linn. It is native to North and Central Europe, and is extensively cultivated in Holland and Russia, Poland, Bulgaria, Rumania, Syria, Morocco and, to a small extent, in England. It has been introduced to the USA where it is grown as a garden crop. It grows wild in India in the north Himalayan regions. It is also cultivated in the plains as a cold season crop and in the hills of Kashmir and Kumaon at an altitude of 2,740 to 3,660 metres, as a summer crop.

The caraway plant usually has a fleshy root and a slender branched stem that attains a height of 0.5 to 0.6 metres; the

compound, pinnate leaves are divided into very narrow segments; the small white flowers are borne in flat compound umbels; the fruit, when ripe, splits into narrow, elongated carpels 4 to 6.5 mm long, curved, pointed at the ends, and with five longitudinal ridges on the surface. The dried fruit or seed is brown in colour, has a pleasant odour, aromatic flavour, warm and somewhat sharp taste (because of the presence of caravone). Seeds are hard and sharp to the touch. They are free from stalk ends. Caraway seed is available whole or ground. The seeds, on steam distillation, yield an aromatic essential oil (4-6%) which finds greater use in medicine than the seeds as such.

The spice is known in the market by the name of the country of origin, as, for instance English, Dutch, and Mogador seed. The Dutch seed is considered the best for distilling and about 10% of Holland's total caraway seed production is used for this purpose.

In India, the fruits are collected before ripening. Well-ripened fruits may also be reaped in the early mornings when the plants are bathed in dew; otherwise many seeds fall during harvesting itself. The plants are dried and the fruits threshed out, cleaned and stored in bags. The yield is very variable. It may be as high as 1000 kg per acre on rich soils, but the average yield recorded in Holland is 300-800 kg per acre.

Composition

Caraway seed has the following composition—moisture: 4.5%; protein: 7.6%; fat: 8.8%; fibre: 25.2%; carbohydrates: 50.2%; ash: 3.7%; calcium: 1.0%; phosphorus: 0.11%; sodium: 0.02%; potassium: 1.9%; iron: 0.09%; vitamins (mg/100g): vit. B_1 (thiamine): 0.38; vit. B_2 (riboflavin): 0.38; niacin: 8.1; vit. C (ascorbic acid): 12.0; vit. A: 580 I.U.; Calorific value (food energy): 465 per 100g of spice.

Other samples of fruits were found to have the following composition: moisture, 11.5-15%; ash, 5.5-6.7%; water-soluble resin, 6.2-10.1%; crude fibre, 17.5-22.3%; and nitrogen, 5.9-6.4%.

Adulteration: The commercial product is often adulterated with spent, or drawn caraway seeds, cumin seeds, carum stems,

gravel and earth. Caraway powder is adulterated with cheap seeds of similar flavour.

Commercial oil is often adulterated with decarvonised oil. The official standards require that the oil should contain not less than 53% and not more than 63% carvone.

Volatile Oil: Caraway oil, distilled from fresh seeds, is a colourless or pale yellow oil, Sp. gr. 15°, 0.907-0.920; Optical rotation at 25°, 70° to 85°; Refr. index at 25°, 1.484-1.498; sol. in 2-10 vols. 80% alcohol; carvone content, 45-65%. Caraway grown in Kashmir gives an oil conforming to the B.P. standard. The volatile oil contains a mixture of ketone, carvone (sp. gr., 0.850), a terpene formerly called carvene but now recognised to be dl-limonene and traces of carvacrol. Pure carvone is prepared by decomposing the crystalline compound of carvone with hydrogen sulphide.

Uses

As Food Flavourant: Caraway is widely used as a spice for culinary purposes aad for flavouring bread, biscuits, cakes and cheese. It is also used in the manufacture of 'Kummel' and as an ingredient of sausage seasoning and pickling spice.

It is a mild stomachic and carminative, occasionally used in flatulent colic and as adjuvant or corrective for medicines. However, its volatile oil is employed more often than the fruit itself.

Carvone isolated from caraway oil is used as anthelmintic in hook worm disease. Caraway oil is used chiefly for flavouring purposes and in medicine as a carminative. It is also used to correct the nauseating and griping effects of medicines. For the treatment of scabies, a solution containing 5 parts each of alcohol and oil of caraway in 75 parts of castor oil is recommended. Caraway seed oil is used in oral preparations for overcoming an unpleasant odour or taste.

For Scenting Soaps: When employed for the scenting of soaps, the soap gives the characteristic full note.

Decarvonised oil consists of limonene with traces of carvone and is sold in the market as light oil of caraway. It finds use in

scenting cheap soaps. The characteristics of light oil are: Sp. gr.: 0.848 and Optical rotation: 130°.

An inferior oil, caraway chaff oil, is said to be distilled from the husks and stalks that remain after threshing. The dried, exhausted and pulverised caraway chaff contains 20-23.5% crude protein (of which 75-85% is digestible) and 14-16% fat. It can be used as cattle fodder.

CARDAMOM, GREATER CARDAMOM AND LESSER CARDAMOM

Cardamoms of commerce are the dried capsules of a small group of species or plants belonging to the family *Zingiberaceae*, which contain seeds possessing a pleasant characteristic aroma. All these cardamoms are broadly grouped into two categories:

(a) Small Cardamoms—popularly known as *Chhota Elaichi* (*Elettaria cardamomum*) or the true cardamom.

(b) Large Cardamoms—*Bara Elaichi* (*Aframomum and Amomum* species).

The former is commercially far more important than the latter as it constitutes one of the most important species of the world. *Chhota Elaichi* actually constituted the second most important 'national spice' of India and was rightly known as the 'Queen of Spices', being next to black pepper, the 'King of Spices' which incidentally is also the world's most important spice as far as international trade is concerned. These true cardamoms fetched us during 1981-82 about Rs 30 crores and during 1983-84 about Rs. 16.2 crores of valuable foreign exchange, as compared to the corresponding figures of Rs 28.0 and Rs 29.4 crores earned by black pepper alone. However, since 1987-88 and 1989-90, export earnings from small cardamom tumbled down to about Rs. 3 to 9 crores annually. This was because of low production caused by the onslaught of diseases.

On the contrary, the large or big cardamom is much less

important as will be seen from the export figures (Annexure I). Large cardamoms worth only Rs 18.0 lakhs were exported during 1982-83 as compared to Rs. 16.20 crores earned through small cardamoms. Besides, till recently, there has been considerable confusion in the nomenclature of the large cardamoms belonging to both *Afromum* and *Amomum* genera. However, after several years of careful deliberations by the member-countries, the I. S. O. (the International Organisation for Standardization) has officially recognised 9 species under 3 main groups, i.e. 4 species each under *Aframomum* and *Amomum* genus and one *Elettaria cardamomum* as shown below:

I. Cardamom (*Aframomum* species)

	Botanical Names	*Common English Names*
(i)	*Aframomum augustifolium* (Sonn) K. Schum	Madagascar Cardamom
(ii)	*Aframomum hannburyi* K. Schum	Cameroon Cardamom
(iii)	*Aframomum korarima* (Pereira) Engler	Korarima Cardamom
(iv)	*Aframomum melegueta* (Roscoe) K. Schum	Grains of Paradise or Guinea Grains

II. Greater Cardamom (*Amomum* species)

(i)	*Amomum aromaticum* Roxburgh	Bengal Cardamom
(ii)	*Amomum kepulaga* Sprague et Burkill; Syn. *Amomum cardamomum* Roxburgh	Round Cardamom or Chester Cardamom or Siam Cardamom
(iii)	*Amomum krervanh* Pierre et Gagnipain	Cambodian Cardamom
(iv)	*Amomum subalatum* Roxburgh.	Greater Indian Cardamom or Nepal Cardamom

I Cardamom (*Aframomum* species)

(i & ii) Madagascar and Cameroon Cardamoms

According to Guenther, there is not much difference in these two species. The plants occur in West Africa, East Africa, in

the Seychelles Islands and in Madagascar. The seeds possess an aromatic odour and flavour slightly resembling that of true cardamom seed, but much more cineole-like and cajuput-like.

Several oils have been described in literature. Their yield and composition are summarised below:

Physico-chemical-Properties	*East Africa*	*Cameroon*	*Geiger*	*Geiger*
Yield of oil	4.5%	2.33%	1.72%	1.2%
Specific Gravity at 15°	0.9017	0.907	0.9030	0.9038
Optical Rotation	-16°50′	-20°34′	-6°49′	-3°0′
Refractive Index at 20°	1.46911	—	—	—
Acid Number	0.4	—	—	3.6
Ester Number	4.2	—	—	22.1
Saponification Number	—	—	50	—
Saponification Number after Acetylation	—	—	107	—

Oils of this type are not produced on a commercial scale, chiefly because their odour is not sufficiently interesting and distinctive. It is used as a spice and also in medicine.

(iii) Korarima

Aframomum korarima is found growing in Thailand and some African countries. It is not grown in India. The dried ground spice obtained from Thailand on steam distillation for 8 hours yielded 3.5% of pale yellow volatile oil which had a flat cineoilc odour.

The following compounds were found to be present in the oil (%): α pinene (3.2), camphene (0.2), β pinene (6.8), sabinene (6.7), myrcene (0.4), α phellandrene (0.3), α-terpinene (0.9), limonene (13.5). 1,8-cineol (35.1), terpinene (2.6), p-cymene (3,9), terpinolene (0 4), terminen-4-ol (5.4), α-terpineol (3.4) and geraniol (4.8%). This spice and its oil are not produced commercially. It is used as a spice.

(iv) Grains of Paradise or Guinea Grains

Bot. Name: *Aframomum melegueta* (Roxb.) Schum, K.
It is cultivated to a small extent in Indian gardens. It is a native of Africa, where it is found growing wild. It was also

introduced to the West Indies. It occurs on the west coast of Africa from Congo to Sierra Leone. Hence the name 'Pepper Coast' or 'Melegueta Coast' for this section of Africa. The shrubs furnish the 'grains of paradise'. It is a perennial herbaceous, reed-like plant upto 1.80 m high with distinct leaf and flower-stems, arising from short rhizomes. Leaves sessile or subsessile, basically mostly glabrous or apically shortly pubescent, linear or linear-lanceolate, with numerous close parallel veins, glossy green with a short and rounded ligule; apex acuminate or caudate; base mostly rounded or subcordate, about 18-22 cm long and 1.8-2.5 cm broad. Flowers sometimes upto 13 cm growing rather close to the ground, each one consisting of a very short, bracteat peduncle and a single trumpet-shaded flower, springing from a cluster of reddish, rounded and mucronate bracts; carolla with one erect lanceolate lobe, two narrow linear lobes white or pale violet, and a large horizontal spreading, fan shaped labellum (a petaloid staminode), white tinted with pink, with a red-and-yellow blotch at the base; only one fertile stamen. Fruits flattish, oblong or pear-shaped berries with a persistent calyx, yellow, russet or scarlet and (according to most publications) not fluted but 3-valved; fruit size varying from 4-9 cm, diameter 2.5-3.5 cm; inside the rind, there is a sweet white edible pulp in which there are numerous gold, red-brown (oliver), chestnut-brown (potter) or dark brown seeds. Seeds about 3-4 mm, rather variable in form with a paler, beak-shaped hilum on the granular outside (according to most publications) and a white kernel inside; seeds aromatic and pungent; number of seeds in the berry varying from about 60-100 in wild plants.

'Grains of Paradise' in many aspects resemble the seeds of official cardamom. When rubbed between the fingers, they give off a faint aromatic odour; their taste is hot and peppery. African natives have always esteemed these grains as a most wholesome spice; in fact, newly-captured Negroes were so dependent upon the spice that slaving ships had to carry ample supplies on board. In Europe and America 'Grains of Paradise' are now seldom used, except in veterinary preparations, and for the flavouring of certain types of liqueurs and

vinegars. Formerly, they were employed quite widely as a condiment or spice.

Composition

Very little research has been done on the chemical characteristics of Melegueta Pepper. Furthermore, most of the information is now out of date. This subject, however, is most important for finding new uses for Melegueta Pepper. Again, most of the information is from Fluckiger and Hanbury. Some of the later authors have done nothing else but copy the views expressed in this publication, usually without any comment.

The seeds of the pepper are only feebly aromatic but have a most pungent and burning taste, caused by a small proportion of essential oil. Their pungency is due to paradol, a yellow oily substance, similar to gingerol, present in the fatty oil of the seeds (0.75%). The amount is said to vary from 0.3 to 0.75%. The oil, mainly in the two sub-epidermic layers, is "faintly yellowish, neutral, of agreeable odour, reminding one of the seeds, and of an aromatic, non-acrid taste". The specific gravity at 15.5°C is 0.825.

On steam distillation, the grains yield from 0.3 to 0.7% of a yellowish or slightly brown volatile oil, with a spicy but not too characteristic odour and the following properties—Specific gravity at 15°:0.8970; Optical Rotation: 3°10′; Refractive index at 20°:1 49116; Acid Number: 2.7; Ester Number: 41.2; Ester Number after Acetylation: 63.9; Solubility: not soluble in 90% alcohol. Soluble in 1 vol. of 95% alcohol; slightly turbid with more alcohol. When treated with a 3% solution of sodium hydroxide, about 16% of the oil went into solution. Nothing is known about the chemical composition of the oil. The oil is not produced on a commercial scale.

Uses

There have been many uses that varied over the centuries. It is very probable that there are still many unknown uses, especially in native medicine. The uses may be considered under the headings of medicines, spices and perfumes. Employment as medicine has been strongly interwoven with magical uses too. It has been employed both for man as well as for animal.

Furthermore, we must point out that not only the grains are used, the pulp of the fruits, the stem, the leaves and the roots are also sometimes employed, usually for medicinal purposes.

As a Flavourant: The most celebrated application as a spice in liquid is undoubtedly in the making of 'Hippocras', the famous spiced wine in vogue during the 14th and 15th centuries. It was employed with other spices, such as cinnamon and ginger. It is still used in beer, spirits and cordials, lemonades, vinegar and sauces. The spice gives a fiery pungency to all alcohols and a taste resembling ginger ale.

Melegueta Pepper is also used to season meat and game. In an interesting article by Bouquet and Kerharo, there is an extensive description of an extract used in after-dinner coffee in North Africa in which extracts of Melegueta and other ingredients such as butter, honey, groundnuts and almonds, date seeds and nutmeg are mixed.

In Perfumery: Mention must also be made of perfume, in the manufacture of which the seed oil is currently employed.

In Human Medicine: In human medicine, there are many uses. Before the seeds are mature, the pulp is chewed as a stimulant. The stem is sometimes employed to make an extract used as a purgative in treating tape-worm. An extract of the young leaves is valued as a styptic. Further information indicates the use of Melegueta Pepper in Liberia in a so-called "root bottle", in which the grains are mixed with rum or brandy and drunk as a sexual stimulant. Parts of the plant are often applied externally after pulping to relieve pain. The seeds are taken to cure dysentery; chewed together with cola-nut, they are considered a sedative against tooth-ache; to make aphrodisiacs and abortifacients more palatable; to guard against rheumatism and migraine; to cure fevers, etc. The extract may be used as a fish poison also.

In Veterinary Medicine: In many countries, the plant and particularly the pungent seeds are still valued in veterinary medicines too.

II Greater Cardamom

(i) Bengal Cardamom

Bot. Name: *Amomum aromaticum* Roxb.
Hindi, Bengali; *Morang Elaichi*; Marathi: *Veldoda.*

Description and Distribution

This herb is 0.6-0.9 meter high, indigenous to East Bengal and Assam and distributed over surrounding areas. It is cultivated in the wetter districts of Bengal and Assam, at the foot of the Himalayas. The fruits are produced on pendant spikes. They are narrowly obovoid (3.75 cm) and 3-valved, with numerous seeds in each cell.

Uses

The seeds are used as a spice and are medicinal. They yield about 1-1.2% of oil; Sp. gr 0.92; Optical rotation, 13° containing a large quantity of cineol. This oil does not possess the characteristic odour of cardamom. Cardamoms or 'Winged Bengal Cardamoms' contain an essential oil with a strongly camphoraceous and cineole-like odour and taste. Steam-distillation of the fruit yielded 1.12% of a volatile oil with these properties – Sp. gravity at 15°:0.920; Optical rotation.—12° 41′; solubility: clearly soluble in 1 and more volume of 80% alcohol.

The oil contained cineole, identified by the preparation of several derivatives. The odour of the oil differed markedly from that of true cardamom oil (from *Elettaria cardamomum* Maton). The oil offers no practical interest.

(ii) Round Cardamom

Bot. Name: *Amomum cardamomum* Roxb.

Description and Distribution

As was mentioned earlier, there are other members belonging to the family *Zingiberaceae* (and particularly the genus Amomum), the fruits of which resemble those of *Elettaria cardamomum* Miton, the true cardamom. One of them is *Amomum cardamomum* L., the so-called "Siam", "Round" or "Cluster

Cardamom", which grows in Siam, Java, Sumatra, Thailand and other parts of the East Indian archipelago. The fruits are now seldom encountered in Europe and America. At one time, the fruit was official in the French Codex.

Round or Siam cardamoms occur in small compact bunches; they are smaller than a cherry, roundish, somewhat ovate, and possess a strong camphoraceous and aromatic flavour, resembling that of true cardamoms (*Elettaria cardamomum*) Maton).

Volatile Oil: Distilling the seed of *Amomum cardamomum* L. (Java), 2.4% of a semi-solid liquid, m.p. 42°, with an odour reminiscent of camphor and borneol, was obtained. The oil had these properties–Sp. gravity at 26°:0.909; Optical rotation:–0°20'; Acid number: 0.8; Saponification number: 14; Cineole content (Resorcinol Method): 12%; Solubility: soluble in 1.2 vol. of 80% alcohol. Further, d-borneol and d-camphor were identified in the oil. The crystalline mass separating from the oil consisted of approximately equal parts of d-borneol and d-camphor. However, the oil of *Amomum cardamomum* is not produced on a commercial scale yet.

Uses

The seed is used as a condiment and ground rhizomes are used medicinally for cold.

(iii) Cambodian Cardamom

Little published information is readily available on this species of the genus *Amomum* which is not of much commercial importance.

(iv) Greater Indian Cardamom (Large Cardamom) or Nepal Cardamom

Bot. Name: *Amomum subulatum* Roxburgh.
Hindi, Bengali, Punjabi and Urdu: *Bara Elaichi*; Malayalam: *Perelam*; Sanskrit: *Brihadaela*; Tamil: *Periya yelam*; Telugu: *Peddayelaki*.

Description and Distribution

According to *Wealth of India*, this species is cultivated in

swampy places along the sides of mountain streams in Nepal, Bengal, Sikkim and Assam (eastern Himalayas) and forms one of the important cash crops of the eastern region of India. The leafy stem has oblong, lanceolate green leaves, which are glabrous on both the surfaces. These plants are usually grown along *jhoras* (small springs), in moist and shady sides of mountain streams and along the hilly slopes, usually at an elevation of 765 to 1675 metres above sea level. The plants mature during the third year of their growth, when flowers and fruits are produced. Harvesting is done usually during August to October each year. The fruits are almost of the size of nutmeg and are a cheap and efficient substitute for true cardamoms. The dark red-brown globose capsules (2.5 cm long) contain several seeds in each cell, held together by a viscid sugary pulp. The seeds possess properties similar to those of true cardamom.

The production of large or greater cardamom is reported to have registered 4000 tons from 23,310 hectares. The factors responsible for the decline in cultivation and yield are (*i*) paucity of superior high yielding strains, (*ii*) inadequate knowledge about the cultural requirements of the crop, and (*iii*) neglect of fungal and virus diseases and pests which take a heavy toll since the crop is propagated vegetatively. Nevertheless, as indicated, large cardamom worth about Rs 186 lakhs was exported from India during the year 1988-89. However, its productivity, export potentialities and wider use need to be explored further.

Composition

According to the author's own results, large cardamom had the following chemical composition: The fruit, on an average, comprises: 70% seeds and 30% skins. Moisture: 8.49%; volatile oil: 2 8% v/w; protein: 6.0%; total ether extract 5.31% (non-volatile ether extract: 2.31; volatile ether extract: 3.0%); crude fibre: 22.0%; starch: 43.21; alcohol extract: 7.02; total ash: 4.01%; water-soluble ash : 2.15%; alkalinity of water-soluble ash: 0.90; ash insoluble in acid: 0.42. According to other authors, total ash in whole large cardamom and seeds varied from 5.49-6.56 and 3.45%-4.57%; acid insoluble ash

0.27-0.72% and 0.31-1.3% and volatile oil 0.5-1.50% and 0.9-2.0% respectively.

Volatile Oil: Essential oil is obtained on steam distillation of the crushed seeds which yield 2.5% of dark-brown coloured mobile liquid having a characteristic smell of cineole with the following physical and chemical constants—Sp. gravity at 29°C: 0.9142; Refractive index at 29°C: 1.4600; Optical rotation in chloroform:—18°3′; Acid value: 2.90%; Saponification value: 14 53; Saponification value after acetylation: 40.20; Cineole: 64.94%; Terpinene: 10.7%; Terpeniol: 7.15% Sabinine: 6.6%; Terpinyl acetate: 5.1%; Bisabolene: 3.6% and polymerized oil: 3.6%. According to another author, the dried comminuted fruit was steam distilled for 8 hours yielding 2.5% of a pale yellow volatile oil which had a flat cineolic odour. This was analysed and the percentages of the compounds present were as follows: α pinene (2 0), β-pinene (2.4); sabinene (0.2), myrcene (0.3), α-terpinene (0.2), limonene (10.3), 1, 8 cineol (74.0), γ terpinene (0.2), p-cymene (0.2), terpinen-4-ol (2.0), δ-terpineol (5.6) and nerolidol (1.0).

Uses

In Medicine : The seeds of *Amomum subulatum* have a sharp, good taste and are a tonic to the heart and liver; are astringent to the bowels, a hypnotic, an appetiser and cause belching. The outside covering is good for headache and for the teeth and heals stomatitis. The decoction of seeds is used as a gargle in affections of teeth and gums. In combination with the seeds of melons, it is used as a diuretic in cases of gravel of the kidneys. In certain disorders of the digestive system marked by scanty and viscid secretion from intestine, it promotes elimination of bile and is useful in congestion of the liver. The seeds are used in gonorrhoea and as an aphrodisiac. They have also been found useful in neuralgia in large doses (30 grains), in conjunction with quinine. The seeds are an antidote to either snake venom or scorpion venom. The seeds are also widely used in India as a spice or condiment, and in the preparation of sweetmeats.

In medicine, they are fragrant adjuncts to other stimulants,

bitters and purgatives An oil extracted from them is applied to eyelids to allay inflammation. It is aromatic, stimulant and stomachic.

The ripened fruits considered to be a delicacy, are eaten raw by inhabitants of Sikkim and Darjeeling during September and October.

LESSER CARDAMOM OR TRUE CARDAMOM

Bot. Name: *Elettaria cardamomum* Mation.
(*a*) Minuscula Burkill (*b*) Thwaites.
Family: *Zingiberaceae*

Hindi: *Chhoti Elaichi*; Bengali: *Chhoti Elachi*; Gujarati: *Elaychi*; Kannada: *Yelakki*; Kashmiri: *Aa'l Budu aaa'l*; Malayalam: *Elathari*; Marathi: *Velchi*; Oriya: *Alaichi*; Sanskrit: *Ela*; Tamil: *Yelakkai or Elakkai*; Telugu: *Yealak-Kayulu or Elakkayi.*

Description and Distribution

Lesser cardamom, green cardamom, Malabar cardamom or 'Chhota Elaichi', is the 'true cardamom of commerce' and is popularly known as the 'Queen of Spices'. It is one of the most valued spices of the world. Among the spices of India too, it occupies an eminent position as the second largest foreign exchange earner (Rs 16 to 30 crores annually). It is next to black pepper only in this regard. Till recently, India was the virtual world monopoly holder of cardamom, supplying 90-95% of the world take-off of cardamom; but, of recent, there is a cut-throat competition from Guatemala and other countries. India still meets about 60-65% of the world's demand through the export of 1,400 to 2,300 tons of cardamom to about 50 countries.

India, Sri Lanka, Gautemala and Thailand are the major producers of cardamom in the world. Of course, cardamom is also produced on a smaller scale in Laos, Vietnam, Costa Rica,

El Salvador and Tanzania. Admittedly, the largest area under cardamom is in India, which alone accounts for 90% of the total world acreage.

Indian cardamom tops in quality with its characteristic flavour or aroma. Importers in the Middle East consider it superior to all other cardamoms produced in other countries. However, it does not compare well with Guatemala cardamom in only colour and external appearance. Because of its attractive parrot green colour, Guatemala cardamom is emerging as a potential rival in the Middle East and elsewhere.

In India, Kerala State has the largest area (about 62% of the total), followed by Karnataka State (31%) and Tamil Nadu (7%). (Annexure II).

Cardamom is mostly cultivated in the natural canopy of evergreen forests, at altitudinal ranges between 600-1500 metres, with a warm humid atmosphere, evenly distributed rainfall and a humus-rich loamy soil which together provide the ideal habitat for its successful cultivation.

Cardamoms are the dried fruits (capsules) of a medium-sized herbaceous perennial, 2 to 5 metres tall and native of Western Ghats in South India. Its real stem is the underground rhizome, and the aerial shoot is a pseudostem formed by the encircling leaf sheaths. The leaves are long and lanceolate in shape. Flowers are borne on panicles and they merge directly from the underground stem on long floral stalks. The growth habit of the panicles and the shape as well as the size of the capsules vary in different cultivated varieties/types of cardamoms. The floral stalks emerge in January and flowers appear in April. Flowering, of course, continues up to July-August. Fruits (capsules) start maturing in August-September, and continue further up to December-January. Fruits are trilocular capsules containing about 10-15 seeds in each capsule.

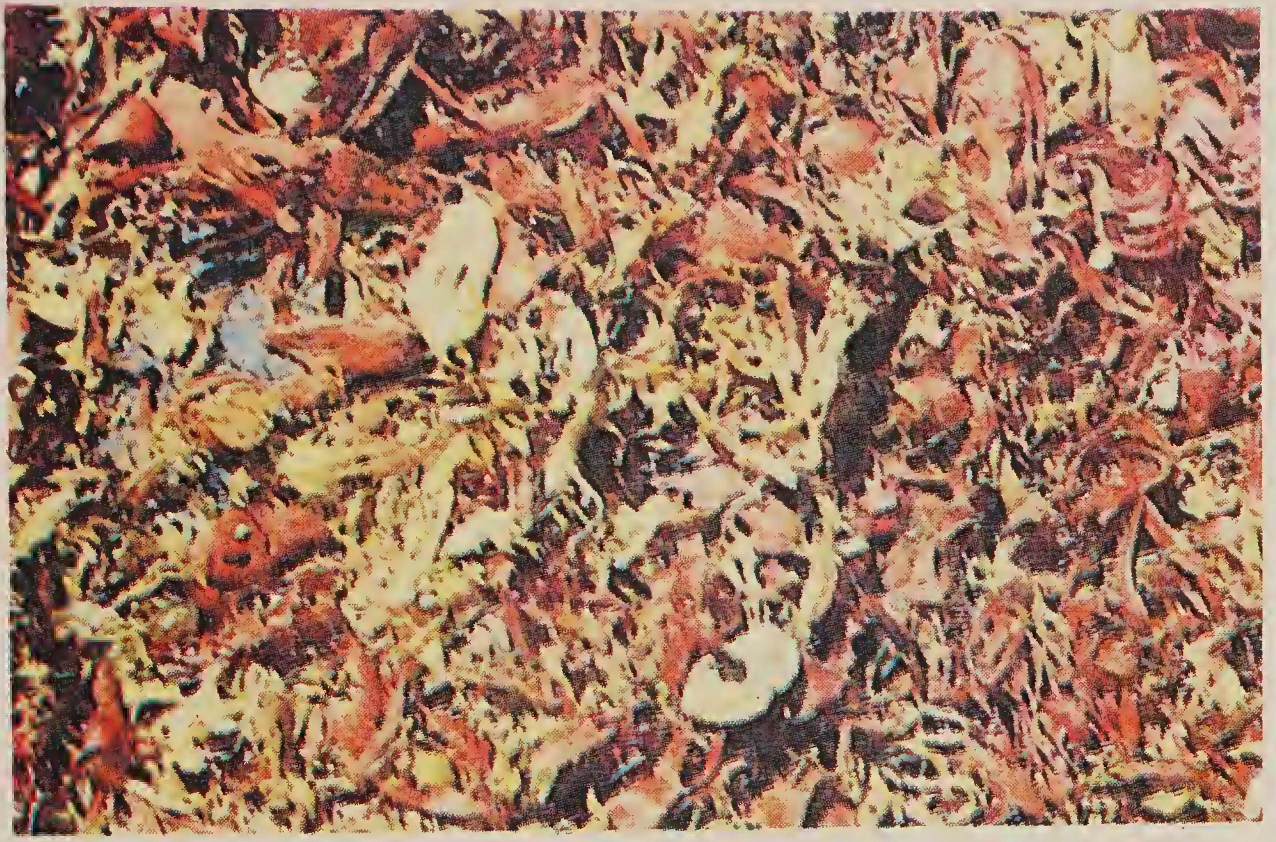
Harvesting and Drying/Curing: Harvesting is generally done once a month, great care being taken to pick only those fruits which are just nearing ripeness, that is, not fully ripe. Fully ripe fruits tend to split on drying and do not develop the desirable rich dark green colour. The harvested fruits are dried in different ways. In large plantations, drying (curing) is done in

Very high yielding clone of green Cardamom (*E. cardamomum*)
(Courtesy: Director, Indian Cardamom Research Instt. Kerala)

Greater Cardamom I-Golsey variety
(Courtesy: Deputy Director, Spices Board, Sikkim)

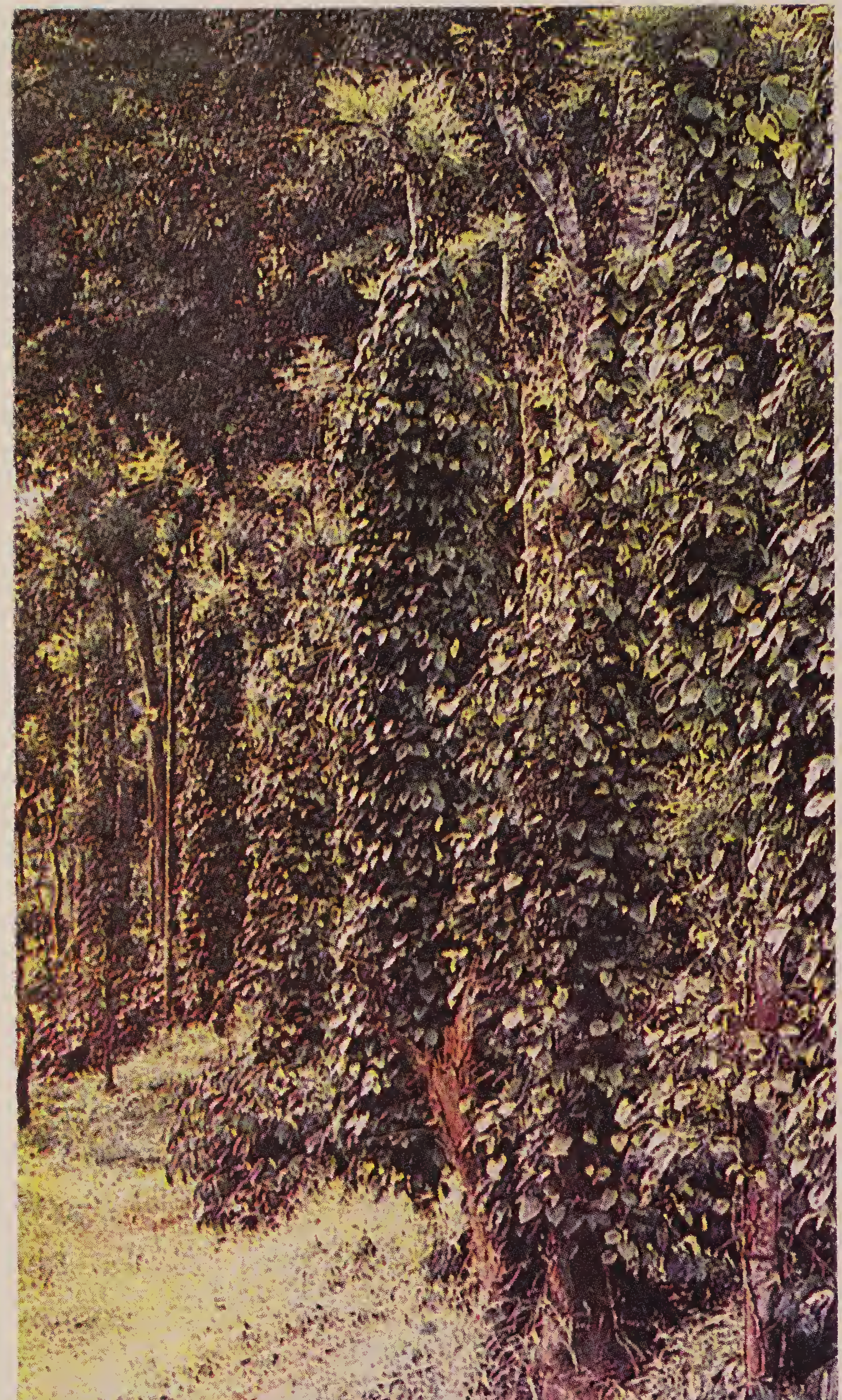
Pusa Sadabahar: Latest variety of Red Chillies with vertically upward bunches of red chillies developed at Divn. of Genetics, IARI, New Delhi
(Courtesy: Dr. Tewari)

Freshly harvested Ginger
(Courtesy: Spices Board)



Mace being sun dried
(Courtesy: Spices Board)

A typical Nutmeg ready for harvest



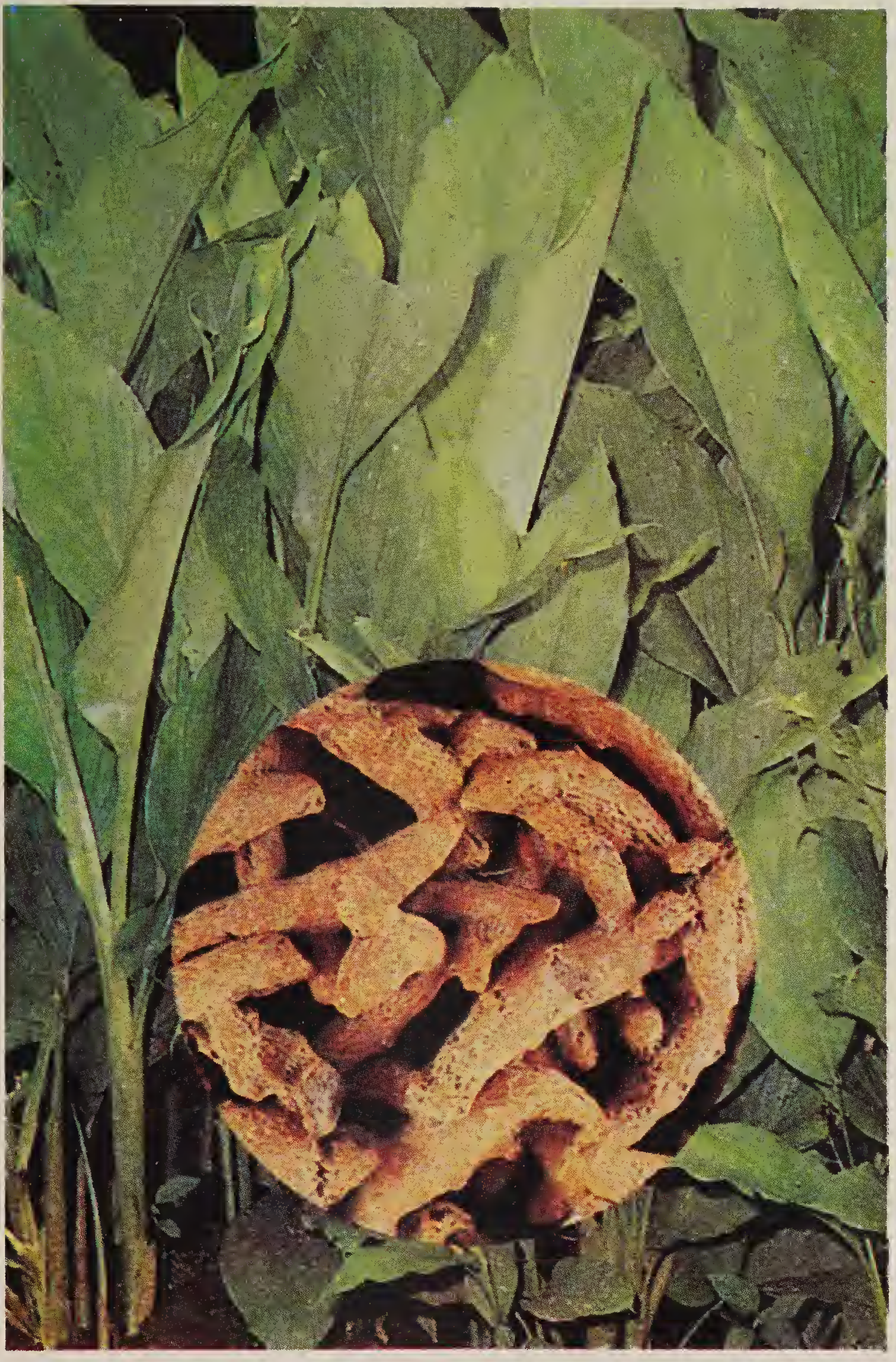
A healthy plantation of Pepper vines (*P. nigrum*) trained on posts or trees in Kerala

Green Pepper spikes of an improved variety— (*P. nigrum*)

Saffron Flowers ready for harvest
(Courtesy: Spices Board)

A crop of healthy Saffron on a neatly laid plot, drain canals alternating with the beds near Srinagar
(Courtesy: Spices Board)

Tamarind tree in full bloom with tamarind pods



Healthy Turmeric plants (Inset : Turmeric Fingers)

Healthy Vanilla Pods on Vanilla vine

Kala Zira-plant in full bloom *(Carum bulocastanum)*
(Courtesy: Dr. G. S. Sethi, H P Agri. University, Palampur)

a drying house in which the fruits are heated by a system of pipes through which hot air from a furnace is passed.

In the small holdings of Coorg and other areas, they are dried on open platforms heated from below and sheltered by a roof open on all sides. Drying is also done on a beaten ground or on a mat in the sun.

Drying in a Heated Chamber—Kiln Drying : The heat is generated by an external furnace and conducted through the chamber by means of flues. A hot-air chamber may be a building with walls of bricks or stones or even of wooden planks and with a tiled roof. A ceiling may be of definite advantage. Inside the chamber are racks for trays. The trays consist of ordinary reeper frames with wire mesh or hessian bottoms. The racks are arranged in tiers 20 to 22.5 cm apart to permit easy manipulation of the trays.

A hot-air chamber with inside dimensions of 4.5×4.5 metres and a ceilling at a height of about 2.5 meters is sufficient for a crop of 1,800 to 2,000 kg. of dry cardamom per annum. Attached to the room is the furnace which is fed from outside. From the furnace, hot air is carried along heating flues which lie a few centimetres above the floor.

Drying should be carefully controlled and should not be too rapid. The harvested cardamoms are placed in trays, which are accommodated in the racks. A tray 26 cm $\times$ 20 cm will contain 3.6 to 5.5 kg. of green cardamoms. The furnace is then lit. Half a cubic yard of good hard firewood will be needed to dry 454 kg of green cardamoms. The cardamoms are dried for about 30 hours at a temperature of about 82°C. Occasionally the trays are withdrawn and the cardamoms turned over. After about 12 hours, the bottom and the top trays are exchanged to enable them to receive uniform heating during the curing. When cured, the cardamoms should be hard and of good greenish colour. At no time during the drying process should they be exposed to strong light which bleaches them.

Dried cardamoms require cleaning to remove all stalks and dried remains of floral parts. This should be done by rubbing dried cardamoms over a coarse surface of wire mesh or bamboo trays. This is done best while the stuff is still hot. For this

purpose, a further drying for about two hours over a charcoal fire or in the hot-air chamber is needed.

If desired, the sorted cardamoms may be graded according to size and colour. The grades are known in the trade as "longs" "mediums" and "shorts".

With regard to the quality of the dried product, larger, round and uniform pods having a good dark green colour always fetch the highest price. The small type of cardamom with the creeping panicles produces round fruits of uniform size and shape, giving a very attractive product. The largest type of bulk gives different kinds of fruits of varying shapes and sizes, from round to longish fruits of nearly an inch in length, resulting in a product of mixed quality. However, the dried product of the larger type retains the dark green colour which makes bleaching for the market (by cardamom traders) easier.

Bleaching of Cardamom: There is some demand overseas for bleached cardamom, though mainly it is sold with its natural attractive green colour. In fact, it is those cardamom capsules which lack the uniform green colour and fetch a low price in the market, that are put through a bleaching process in order to attain uniform colour and appearance. Bleaching agents like bleaching powder, sulphur dioxide or hydrogen peroxide are generally used for this purpose. Sulphur dioxide gas is obtained either through the burning of sulphur powder in a closed chamber containing cardamoms or by wet sulphitation process i.e., by steeping cardamom in dilute solution of water-soluble salts of sulphur dioxide, such as potassium meta-bisulphite or potassium bisulphite. Bleaching has been developed into a scientific and paying profession in Sweden. In South India, bleaching of cardamom is done with bleaching powder and/or sulphur dioxide.

In spite of bleaching being a costly and time-consuming process, no material benefit is reported to be derived out of it except an improvement in the outer appearance of the pericarp which is often thrown away and a slight improvement in the keeping quality of cardamoms. On the other hand, it reduces the percentage of volatile oil in the seeds and imparts a sulphurous odour to the produce. The majority of cardamom

traders and processors consider it an unnecessary luxury indulged in by certain consumers overseas. They believe that once the foreign consumers show preference for green or sun-dried cardamoms, bleaching of cardamoms would automatically stop.

Varieties/Types of Cardamoms: On the markets, cardamoms of different colours, sizes and shapes are available. Their colour ranges from attractive green to brown. Green colour is an indication of its freshness. The real quality lies in the seeds as the skin is generally thrown away. Most of the aroma which is due to essential oil and other volatile compounds resides in the seeds. While purchasing, effort should be made to see that they are not cracked, hollow or empty, shrivelled, immature or insect infested, and possess the characteristic aroma. The capsules should be compact and full of seeds. Size may not be so important though bigger and green cardamoms are invariably costlier than the other grades.

The Government of India and ISI have prescribed fairly well defined grades, popularly known as 'Agmark' grades, an Indian specification or standard on the basis of important quality factors like colour, weight per unit volume (litre), size and percentage of 'empties', malformed, shrivelled and immature capsules. Separate specifications (about 33) have been laid for different qualities or types of cardamoms such as 'Alleppy Green', 'Coorg Green', 'Bleached', 'Half Bleached', 'White' and 'Mixed' cardamoms. Consumers should preferably go in for Agmark graded cardamoms. Secondly, natural cardamoms should be preferred to the so-called 'Bleached' or 'Half Bleached' cardamoms.

Composition

The composition of cardamom varies slightly with the variety, region and age of the product. The following data cover the range of variations in Indian cardamom (seeds)—moisture : 7-10% (av. 8.3); volatile oil: 5.5-10.5% (av. 8.3); total ash: 3.8-6.9 (av. 5.0); alkalinity of ash: 0.4-2 4% (av. 1.1); water-soluble ash 1.3-5.0% (av. 2.7); acid insoluble ash: 0.4-1.9% (av. 1.1); non-volatile ether extract: 2.0-4.5% (av. 2.9); crude fibre: 6.7-12.8% (av. 9.2); crude protein: 7.0-14.0 (av. 10.3%); starch (by

acid hydrolysis); 39.0-49.9 (av. 45.4); calcium: 0.3%; phosphorus 0.21%; sodium: 0.01%; potassium: 1.2%; iron: 0.012%; vitamins (mg/100g) vit. B_1 (thiamine): 0.18; vit. B_2 (riboflavin); 0.23%; niacin: 2.3; vit C (ascorbic acid): 12.0 and vitamin A: 175 International Units per 100g. of the seeds.

Analysis of cardamom capsules shows the following—moisture: 20%; protein: 10.2%; ether extract: 2.2%; volatile oil: 7.4%; mineral matter (total ash): 5.4%; crude fibre: 20.1; carbohydrates: 42.1%; calcium: 0.13%; phosphorus: 0.16%; iron: 5mg/100g.

Uses

As Masticatory and Flavourant: A good portion of the cardamom produced in India is consumed internally, for chewing or as a masticatory, as a common ingredient of special seasonings and curry powders and flavouring sweetmeats, pastries, cakes, other bakery products, gingerbread, puddings, kheer, meat curries, sausages, various kinds of foods and culinary preparations. It is also used in sweet pickles. Its essential oil is used for flavouring certain bitters and liquors and also in the manufacture of perfumes. In Arab countries, social and religious functions are never complete without serving *gahwa*—a special cardamom-flavoured coffee.

Use in Medicine: Tinctures of cardamom are also made, used chiefly in medicines for windiness or stomachic. Powdered cardamom seeds mixed with ground ginger, cloves and caraway is helpful in combating digestive ailments. In medicine, it is used as a powerful aromatic stimulant, carminative, stomachic and diuretic. It also cheeks nausea and vomiting and is reported to be a cardiac stimulant also.

A good nasal application is prepared by using extracts of cardamom, neem and myrobalans along with animal fat and camphor. Cardamom seeds are chewed to prevent bad smell in the mouth, indigestion, nausea and vomiting due to morning sickness, excessive watering in the mouth (pyrosis), etc. Gargling with the infusion of cardamom and cinnamon cures pharyngitis, sore throat, hoarsensess during the infective stage of flu. Its daily gargle protects one from flu.

Powdered seeds of cardamom boiled with tea-water imparts

a very pleasant aroma to the tea, and the same can be used as a medicine for scanty urination, diarrhoea, dysentery, palpitation of the heart, exhaustion due to over-work, depression, etc.

Eating a cardamom once daily with a tablespoon of honey improves eye-sight, strengthens the nervous system and keeps one healthy. It is believed by some people that excessive use of cardamom causes impotency.

CASSIA

Cassia (*Jangli Dalchini*) and Cinnamon (*Dalchini* or *Darchini*) are very popular spices commonly used in the Indian dietary. The name *Darchini* which has come to stay in Indian parlance, is actually a derivation from the Arabian term *Dar-al-chini*, meaning the wood (or bark) of China, one of the oldest and largest producers of China Cassia so well-known in commerce. Several reports indicate that cinnamon is one of the oldest spices known to mankind. Records show that it was known to Egyptians even 2000 years before Christ! European and Arabian travellers/writers confirm the trade in cinnamon and cassia from Sri Lanka, Seychelles, China, Indonesia and West Coast of India to other countries. Even today, cinnamon and cassia occupy an important position in world trade. In pre-war years, trade in cassia used to be more important than in cinnamon but the situation has now changed. According to F.A.O. estimates, the total trade in cinnamon and cassia is around 35 million dollars (about Rs. 35 crores) and the world demand for these spices is growing. The demand for cinnamon and cassia has been so considerable that during the fifties, India used to be the second largest importer of cassia in the world, being next to the USA but now imports have decreased to 37,193 kg of cassia worth over Rs. 3.75 lakhs and cinnamon leaf oil to 6,954 kg worth about Rs. 1.33 lakhs (F.A.O. estimates). Thus, the total imports of cassia etc. come to over Rs 5 lakhs. This is in addition to what is already produced in the country itself.

Cassia is generally considered inferior to cinnamon, but is often used as its substitute. Cassia and cinnamon, when whole, can be fairly easily distinguished from each other, the former being with coarser skin of greater thickness and milder in flavour. However, when in the ground form, it is rather difficult to identify the admixture or purity.

Cinnamon and cassia of commerce consist of layers of dried inner barks of branches of a number of species of evergreen tropical trees belonging to the same genus *Cinnamomum* family *Lauraceae*. There appears to be considerable confusion about the nomenclature of these species. The same species is known by 6-10 different names in different producing countries. However, after careful prolonged discussions by the member countries under the aegis of I.S.O., the following spcies have been officially recognised.

Popular Names	*Botanical Names*
(A) CASSIA	
(i) Cassia China or Cassia	*Cinnamomum aromaticum* C.G. Nees or *C. Cassia*.
(ii) Batavia Cassia or Java Cassia or Cassia Vera or Padang Cinnamon	*C. burmannii* Blume.
(iii) Saigon Cassia	*C. laureirii* Nees.
(B) CINNAMON	*Cinnamomum zeylanicum* Blume

So far as India is concerned, the most important aromatic barks which are in commercial use, are (*i*) the genuine or 'true cinnamon' (*C. zeylanicum*), (*ii*) *Karuva* or Jangli-Darchini (*C. inners*); (*iii*) Tejpat or Tamal Patra or Indian Cassia Lignea (*C. tamala*); (*iv*) Tezpat or Ram Tazpat (*C. obtusifolium*). These are briefly described below:

(i) Jangli-Darchini (*Cassia*)

Bot. Name: *Cinnamomum inners* Reinw.
Family: *Lauraceae*.
Hindi: *Jangli Darchini*; Kannada: *Adavi lavangapatte*: Marathi:

Tikhi, Ranacha Dalchini; Tamil: *Kuttukkaruvapatty*; Telugu: *Aduvi lavangappatte.*

Description and Distribution

A large evergreen tropical tree reported to occur in the evergreen forests on the Western Ghats from Mysore and Coorg to Annamalais and Kerala, etc. The method of preparation and curing is the same as described under cinnamon.

Uses

The end use of the bark is the same as that of cinnamon reported later.

The bark contains 0.5% volatile oil with the odour of cloves and musk. Its wood is light brown, fairly hard, shining. It machines well, takes on a good finish and hence can be used for the manufacture of light furniture.

(ii) Tejpat (Indian Cassia Lignea)

Bot. Name: *Cinnamomum tamala* Ness and Eberm
Family: *Lauraceae.*
Hindi, Bengali, Punjabi & Urdu: *Tejpat*; Gujarati: *Tamalapatra*; Marathi: *Darchini*; Sanskrit: *Tamalaka* (Tejpatra); Tamil: *Talishappattiri* and Telugu: *Talisapatri.*

Description and Distribution

A moderate-sized evergreen tree attaining a height upto 8 metres and a girth of 1.4 metres, distributed in tropical and sub-tropical Himalayas (915-2440 metres altitude), Khasi and Jaintia hills (915-1220 metres altitude), and in Eastern Bengal.

The species is the source of Tejpat leaves used extensively in northern India as a spice. The bark of the tree, known in trade as Indian Cassia Lignea, is collected from trees growing at the foot of the Sikkim Himalayas. There are regular plantations of *C. tamala* in Khasi and Jaintia Hills, Garo Hills, Mikir Hills, Manipur and Arunachal. Tejpat is grown mainly in the Jaintia Parganas of Sylhet district. Many plantations in this tract are self-sown; a few are planted. Although exact statistics are not available, the total area covered is approximately 600 acres, mostly in the north-eastern region of India,

distributed largely in the Himalayas at 250 to 700m. above sea level.

Leaves are ready for harvesting when trees are 10 years old and they continue to bear for a century. Leaves are collected every year from young vigorous plants and in alternate years from old and weak ones. Collections are made in dry weather from October to December till March. Continuous rain diminishes the aroma of the leaves. Small branches with leaves are dried in the sun for 3 for 4 days and tied up into bundles for marketing. Sometimes the leaves are separated and packed in cylindrical bamboo nets called *bora* or *gungra*. A tree yields 20-50 lb of dry leaves per year.

Uses

The leaves are used mainly as a spice. In Kashmir, they are used as a substitute for pan or betel leaves. It takes in Indian cookery the place of Bay leaves in Europe. It is used as a clarifier in dyeing with myrobolans or kalala.

The leaves of *C. tamala* are carminative and are used in colic and diarrhoea. The bark is aromatic. It is coarser than the bark of cinnamon (*C. zeylanicum*) and is one of the common adulterants of true cinnamon.

Leaf Oil : The leaves yield about 2% essential oil with the following characteristics: Sp. gr. 1.025; $(\alpha)D$, 16°37'; nD 20°, 1.526. It is soluble in 1.2 vol. of 70% alcohol. The oil contains 80-85% eugenol while imported oil contains 75-80%. The oil resembles cinnamon leaf oil and also contains d-phellandrene. The Regional Research Laboratory of CSIR, Jorhat (Assam) has done considerable work on *C. tamala* leaf oil and has established the economic feasibility of this important by-product and its utilisation.

Bark oil : The essential oil from bark is pale yellow, and contains 70-85% cinamic aldehyne. The trade in cassia has declined appreciably with the advent of synthetic cinnamic aldehyde. The oil is often adulterated with cheap terpenes.

(iii) **Tezpat**

Bot. Name: *Cinnamomum obstifolium* Ness
Family: *Lauraceae*

Assamese: *Patichanda*; Bengali: *Kinton*, *Ram Tezrat* or *Tezpat* Kumaon: *Phatgoli*; Nepal: *Barasingoli.*

Description and Distribution

A large robust tree occurring in the central and outer eastern Himalayas, Bangladesh, Assam and Andaman Islands.

Uses

The wood (wt. 38-44 lb/cft) is reddish grey, moderately hard and shining. It is generally used in Assam for making charcoal. The timber is said to be suitable for tea boxes and planking. The leaves, also known as Tejpat, are aromatic and are put to the same uses as those of *C. tamala.* The bark, especially that of the root, collected in Marataban, resembles Sri Lanka cinnamon. It is used in dyspepsia and liver complaints in Nepal.

(iv) Cassia or Cassia China

Bot. Name: *Cinnamomum cassia* Blume *or C. aromaticum*
Family : *Lauraceae*

Description and Distribution

This commercially important product originates from *C. cassia* cultivated in the provinces of Kwajgsi, Kweichow and Kwangtung in China. The bark is the regular 'Cassia lingena' of commerce. Because of its brittleness, much of the bark is fractured, thus yi˽lding the 'broken' grades. The main grades are (a) Whole Quills or China Rolls, (b) Selected brokens or Canton Roll, and (c) Extra selected brokens. Otherwise, the more popular 4 grades are: 'thin', 'medium', 'thick' and 'broken'. Trees growing at higher altitudes (180-300 metres) yield better quality bark with higher volatile oil content. Trees growing at lower altitudes (90-150 meters) yield a relatively thick, coarse bark, somewhat deficient in flavour, containing 1.0 to 1.2% of volatile oil.

The cassia tree is larger than that of cinnamon, with more oblong-obtuse leaves having short thick stalks, blunt lobes to the perianath and a fruit smaller than that of Ceylon cinnamon. The pale yellow flowers, which are borne in panicles,

pollinated mostly by flies, and the seed is dispersed by birds which swallow the pulpy blackfruit as soon as it is ripe. These fruits when dried before maturity constitute the well-known 'Cassia buds', known in India as *Kala Nagkesar*. The bark has been known from the earliest times.

Though this species of cassia is not grown in India, considerable quantities of it are imported into the country as mentioned earlier. Hence, it is of interest to know more about it. Cassia trees are grown in China on artificially terraced hillsides at altitudes ranging from 90 to 305 metres above sea level.

Preparation/Curing of Cassia Bark: When the trees are about six years old, the first cut of bark is obtained. The season for working commences in March and continues till the end of May, after which the bark loses its aroma. The branches, which are about 2.5 cm thick, being cut to within a few cm of the ground, are carried to houses and shades in the vicinity of the plantations, all the twigs and leaves being cleared off. A large-bladed knife, with the cutting edge like the end of a budding knife, is used to make two longitudinal slits and three or four cuts, 50 cm apart, round the circumference through the bark. The bark is then loosened by passing underneath it a slightly curved hornknife, with the two edges slightly sharpened. Pieces of bark 40 cm long and half the circumference are thus obtained.

The bark, after its removal and while it is still moist with sap, is then laid with the convex side downwards. A small plane is then used to remove the epidermis, which is also removed by scraping. After this operation, the bark is left to dry for about twenty-four hours, and then tied up in bundles of about 45 cm diameter and sent to market towns.

Composition

The composition of cassia will vary from species to species, region to region *vis-a-vis* agro-climatic factors. The following is the range of variation in different cassias: moisture: 6-5-11. 9%; volatile oil: 0.5-5.1%; cold alcohol extract: 4.6-16.7%; fixed oil: 0-2.1%; carbohydrates: 6.9-32.0%; crude fibre: 12.0-28.8%; protein: 3.1-3.4%; total ash: 1.9-8.2%; acid insoluble ash: 0.02-0.42%.

The important constituent of commercial importance is the volatile oil which finds numerous uses in various culinary preparations, perfumery and cosmetics as well as in pharmaceutical/medical preparations.

Cassia Oil: Cassia oil is distilled in country still by the water distillation process. The material used for distillation is the inferior or broken bark, leaves, flowers and peduncles, the major component being leaves (70%) and twigs and inferior bark (30%). The oil is somewhat similar to the cinnamon oil, but pleasant to a lesser degree. Cassia oil differs from cinnamon oil in that only one type of oil is produced from the various parts of the tree. Cinnamic aldehyde is the main constituent of cassia oil i.e. at least 80%. It goes upto 93%, as reported below:

Variations in yield and quality of cassia oil obtained from different plant components of *C. cassia*:

Source: plant part	*Yield of oil* (%)	*Sp. gravity at* 15°/15°C	*Cinnamic Aldehyde* (%)
Leaves	0.54	1.056	93.0
Branches	0.20	1.045	90.0
Cassia buds	1.90	1.026	80.4
Pedicels	1.70	1.046	92.0
Mixture of leaves, stalks and twigs	0.77	1.055	93.0

Adulteration in Cassia Oil: Pure cassia oil is very rarely exported from China. It is generally adulterated with a mixture of rosin and kerosene and sometimes even with synthetic cinnamic aldehyde or a mixture of this aldehyde and benzyl acetate. In addition to these adulterants, cassia oil almost invariably contains lead, as a result of the action between the free cinnamic acid in the oil and container in which the oil is usually packed. It is, therefore, necessary that the cassia oil intended for use in foods or pharmaceutical preparation be rectified by distillation.

Cassia Buds: These are popular among Oriental nations as an article of flavour The buds are the unripe fruits of the cassia tree. When the petals drop off from the opened flower,

the sepals swell and enclose the small black fruit. These fruits along with the calyx cup are known as 'buds' in commerce. They are collected in China when they are comparatively young. The Malayan practice is to collect them when the fruits are fully mature, and the Malayan commodity is said to be more in fancy than the Chinese buds on account of its better flavour.

For flavouring chocolates, some countries, particularly Russia and Germany, prefer cassia buds to cinnamon buds on account of the stronger aroma of the former.

(v) Batavia Cassia

Bot. Name: *Cinnamomum burmannii* Blume
Family: *Lauraceae*
Other common names: *Indonesiam Cassia, Java Cassia, Cassia Vera or Pedang Cinnamon.*

Description and Distribution

Batavia cassia grows wild throughout the Malay Archipelago and yields a product of high value, though lower than that of cinnamon. All the so-called cinnamon bark from Sumatra, Java, Celebes and Timor is said to be drived from this species as is also that grown in the Philippines and shipped from Manila. The tree is found at all altitudes i.e. from sea level to 1830 metres, but grows best between 450 and 1350 metres. The most aromatic plants come from light, rich, sandy loams, although the tree grows well in other soils provided they are sufficiently open. The yield is variable, being dependent upon such factors as altitude, soil and whether wild or cultivated.

The best bark comes from the trunk; the bigger the trunk the thicker and more valuable the bark. The dried quills are sorted into 3 grades, A, B, C, according to their quill length, colour thickness and aroma, tied tightly into bundles which are then sewn up into jute sacks.

India and the USA impart cassia. Batavian cassia alone constitutes about 82% of total imports of three species of cassia and cinnamon into the USA. India, however, re-exports some cassia as well as the local produce.

(vi) Saigon Cassia

Bot. Name: *Cinnamomum laureirii* Nees
Family: *Lauraceae*
Other common names: *Indo-Chinese Cassia, Royal Cinnamon,* 'Que-thanh,' etc.

Description and Distribution

Saigon Cassia also is one of the important cassias in international trade. Out of the 4 species of cinnamomum grown in Indo-China, the species *C. laureirrii* constitutes the principal source of Saigon Cassia. It occurs throughout the country from the upper Tonkin to Cochin China. The tree grows in any soil, even the poorest, but well-drained mountain slopes suit it best. It is now cultivated in the Annam area.

Barking: The best and the most expensive bark 'Que-thanh' or Royal cinnamon comes from the province of Thanh-hoa in north Annam. Barking, that is removal of bark, is usually carried on the standing tree, starting with the main branches and working down the trunk, not by climbing but by erecting bamboo scaffolding around it. A string is tied round the trunk and main branches at intervals of 40 cm and the bark is cut through at these points with a sharp pointed knife. Then vertical cuts are made between the horizontal incisions at intervals of 25-35 cm and the slabs of barks are eased off with the aid of thin spatulas made of bamboo or buffalo horn. Each ring of bark is removed in this way until the bottom of the trunk is reached; the tree is then felled after which small branches and twigs are harvested.

In Quang-nam and other areas, it is usual to remove a ring of bark at the base of the trunk, proceeding with the main operation after a period varying from a few days to a month. The removal of this ring of back arrests the flow of sap and renders the remainder of the bark easier for removal. In some plantations, the trees are left standing with sufficient bark on the trunk (30 cm to 1.2 metres above ground level) to give them a reasonable chance of survival.

Preparation and Processing of Bark: The bark is marketed in two forms, (i) square pieces, unscraped and unrolled (the

pieces are actually gutter-shaped), and (ii) quills, which are often scraped. The former known as 'Canelle plate' or 'banque' is used principally in China, whereas the quills called 'Canelle roulee' or 'dong que' are preferred in the Western markets. It may be noted that the former is prepared exclusively from the trunk and the main branches, the latter (quills) are obtained principally from the bark of the smaller branches.

The unrolled bark is subjected to much more elaborate processes of preparation than quills. The bark is soaked in water for 24 hours, then washed and dried in the shade. It is then fermented for 2 days in closely woven bamboo baskets so thickly lined with dry banana leaves that the bark is almost hermetically sealed.

It is again washed and dried in the air and shade on bamboo screens, being wiped from time to time to remove the mildew, when sufficiently dried so that no more mildew forms. The bark is bound tightly on to pieces of thick bamboo. Thus compressed, it assumes the shape of the bamboo and becomes smooth and polished. Twice daily, it is untied and wiped. This treatment takes two weeks in summer or a month in winter.

However, it may be added that the method of preparation and packing varies somewhat in different parts of the world. A much simpler method is used in Quang Nam where the pieces of bark are dried merely by spreading them on bamboo racks raised off the ground, and covering them with banana leaves. In order to prevent the pieces of bark rolling up, rods of bamboo, a little shorter than the width of the pieces, are placed transversely at top, middle and bottom, being held in place by the curled edges of the bark. When dry, the bark is finished to the requirement of purchasers. The whole process takes a few days for thin bark, but upto a month for thick bark.

Likewise, a method of 'fire-drying' is also used for drying both wild and cultivated bark.

Quills are prepared by scraping the detached bark to remove the outer coarse, valueless bark, and drying. Quill formation takes place automatically on drying, but the process may be assisted by suitable manual pressure and rolling. For the Chinese trade, bark has to be packed so that it retains its aroma and essential oil during prolonged storage. The small quantities

are preserved by wrapping in linen, the ends being waxed or by packing in zinc canisters. Large quantities are packed in zinc lined wooden boxes/cases, divided horizontally into two compartments by a bamboo tray. The lower compartment is filled with honey and the bark is arranged in layers on the tray. It is claimed that the bark keeps indefinitely provided the cases are kept tightly closed.

For export to Western markets, the quills are packed in bales of 133 1/3 and 65 2/3 lbs and are graded as 'thin', 'medium' and 'thick'. The broken quills are sold in two grades, 1 and 2, according to quality and appearance.

Uses

The end uses of all cassias are almost the same as those of the cinnamon, i.e. used for flavouring of bakery, confectionery and numerous curried food products, in medicine and in perfumery and cosmetics, specially cassia oil and cassia bud oil, etc.

CELERY SEED

Bot. Name : *Apium graveolens* Line. var. *Chanu Celery*
Family : *Umbelliferae*
Hindi : *Shalari*, *Ajmud*; Bengali : *Bandhuri*, *Chanu*; Gujrati : *Bodiajmoda*; Marathi : *Ajmoda*; Punjabi : *Kernauli*; Sanskrit : *Ajamoda*; Tamil : *Ajmada.*

Description and Distribution

Celery seed is the dried ripe fruit of the umbelliferous herb, usually 60 to 180 cm high, erect, with conspicuously jointed stems bearing well-developed leaves on long expanded petioles. The rigid fruit is small, 1 to 1.5 mm long and 1 mm in diameter, contains a small seed, united or separated, pericarp-some with stalk ends, brown in colour and somewhat bitter in

taste. The epicarp is intercepted with oil ducts. It is widely used as a spice. The native habitat of celery extends from Sweden to Egypt, Algeria and Ethiopia, and in Asia, to India, Caucasus and Baluchistan. It is also claimed to be first mentioned as a cultivated food plant in France in 1623 ! Of course, celery is cultivated both for salad and seed-raising in the north-west Himalayas, Punjab, U.P., and France and the USA. In the Amritsar district of Punjab alone, about 300 acres had been put under this crop in the *rabi* season (1969-70). Celery seed is in great demand both in India and abroad. During the year 1982-83, about 2,030 tonnes of celery valued at Rs 1 crore and 41.0 lakhs were exported from India to several countries, Thus, celery seed is one of the very important minor spices of India. During recent years, its export figures have further gone up and almost doubled. Indian celery seed is exported mostly to the UK and the USA, and to a lesser extent to continental countries like France, Italy, the Netherlands. West Germany, as well as to Australia and New Zealand.

In colder climates and on the hills, celery is a biennial crop and produces seeds only in the second year, but in the plains, it becomes an annual and produces seeds in the very first year. It is a moisture-loving plant, requiring a cool climate.

Celery seed is available as whole or ground. It is subject to adulteration by addition of exhausted or spent seeds (from which oleoresin or oil has been extracted), excess stems, chaff, earth etc. The ground celery is sometimes adulterated with farinaceous products, linseed meal, worthless vegetable seeds or weed seeds etc.

Composition

Moisture 5.1%; protein: 18.1%; fat (ether extract): 22.8%; crude fibre: 2.9%; carbohydrates: 40.9%; total ash: 10 2%; calcium : 1.8%; phosphorus : 0.55%; iron: 0.45%; sodium: 0.17%; potassium: 1.4%; vitamins (mg/100g): vit-B_1 (thiamine): 0.41; vit B_2 (riboflavin): 0.49; niacin: 4.4; vit. C (ascorbic acid): 17.2; vit. A: 650 International Units; Calorific Value (food energy): 450 calories/100g.

According to another source, the variation in important

quality characteristics is as follows—moisture: 5-11%; volatile oil: 1.5-3.00; (average 2.4%); non-volatile ether extract: 5.8-14.2% (average 9.4%); cold water extract: 5.9-12.6%, (average 8.4%); total ash: 6.9-11.0% (average: 8.8%); ash insoluble in acid: 0.5-4.0% (average 2.5%).

Fresh celery leaves and stalk have the following typical composition respectively—moisture: 81.3, 93.5%; protein: 6.0, 0.8%; fat: 0.6, 0.1%; fibre: 1.4, 1.2%; carbohydrates: 8.6, 3.5%; mineral matter: 2.1, 0.9%; calcium: 0.23, 0.3%; phosphorus: 0.14, 0.4%; iron: 0.06, 0.05%; vit. A: 5800, 7500, I.U. vit., B_1: trace; vit. C: 62, 6 mg/100g; Calorific Value: 64, 18, calories per 100g.

From the foregoing, it is apparent that leaves are more nutritious than stalk, particularly from the viewpoint of protein, vitamins, A and C.

Volatile Oil: The celery fruits yield 2-3% of a pale yellow volatile oil with a persistent odour, characteristic of the plant. In trade, this is known as celery seed oil and is much valued both as a fixative and as an ingredient of novel perfumes. The oil has the following constants—Sp. Gr. : 0.850-0.875; Refractive Index: 1.478-1.486; Optical Rotation: +65° -82°; acid val. upto 5 ester val.: 15-40. The principal constituents are—d-limonene: 60%; d-selinene; 10%; sedanonic acid anhydride: 0.5% and sedanolide: 2.5-3%. The last two are responsible for the aroma of the oil. The volatile oil from the green leaves (0.1%) is of no commercial importance.

Celery Chaff Oil has a somewhat harsher and coarser odour and flavour than that of celery seed oil. Oil of celery seed is frequently adulterated with chaff oil or with d-limonene, the addition of which is difficult to detect. It has been further reported that the odour and flavour of Indian celery seed oil are normal, but usually not quite as fine as those of French celery seed oils.

Oleoresin of **celery seed** is prepared by extracting the crushed dried celery seeds with suitable volatile solvents, filtration and desolventization under vacuum. The oleoresin possesses not only the volatile top note of the essential oil, but also the 'body' i.e. the fixed or non-volatile extractive matter of the celery used. Oleoresin could rightly be considered as 'liquid

celery seed' which is easier to handle in the preparation of tinctures and extracts.

The volatile oil content of celery leaves is too low to permit its economic distillation and hence it has not attained any commercial importance at present. However, the *celery herb oil* is quite different from *seed oil*, the former being more representative of the plant as such. Doubtlessly, this new type of herb oil could be introduced to great advantage in many products of our food industry.

Uses

As a Food Flavourant : The dried ripe fruits (celery seeds) are used as spice. Leaves and stalks are used as salads in soups and as a pre-dinner appetizer.

In Medicine : They are stimulant and tonic, used in asthma and for liver diseases. Essential oil contracts gravid and virginal uterus. As a domestic medicine, seeds are used as nervine sedative and tonic. A domestic remedy for rheumatism is a 1-in-20 decoction. Celery seeds are the main ingredient of celery tonics.

Fatty Oil : The fruits also yield 17% of a fatty oil—*oil of celery*. This is used as an anti-spasmodic and nerve stimulant. It has been successfully employed in rheumatoid arthritis and probably acts as an intestinal antiseptic. The root is considered alternative and diuretic and is given in anasarca and colic.

Celery seed serves as a bird food also.

In Perfumery : The commercial use of celery seed oil is as a fixative, as an important ingredient in novel perfumes, in medicine and in the flavouring of different kinds of foods—canned soups, meats, sausages and particularly in the flavouring of the popular celery salts, celery tonics and culinary sauces. Celery seed oil is one of the most valuable flavouring agents as it imparts a warm, aromatic and pleasing flavour to food products.

CELERIAC

Bot. Name : *Apium graveolens* var *rapaccum* de Candole
Family : *Umbelliferae*

Description and Distribution

Celeriac is another cultivated variety of *A. graveolens*, somewhat smaller in size than celery, has dark-green foliage with less developed stalks and swollen roots, 5-6.5 cm in diameter. This is also called turnip-rooted celery. It is grown to a limited extent in U.P. and Punjab, and in France.

Composition

The leaves of celeriac contain—moisture : 81.3%, carbohydrates : 8.6%; fat : 0.6%; protein : 6.0%; calcium : 0.23%; phosphorous : 0.04%; iron : 6.3 mg; vit. A : 5,800-7,500 I.U., and vit. C : 62 mg/100g.

The stalks contain—moisture : 93.5%; carbohydrates : 3.5%; fat : 0.1%; protein : 0.8%; calcium : 0.03%; phosphorus : 0.04%; iron : 4.8 mg; vit. A : nil and vit. C : 6 mg/100g.

Traces of copper and arsenic are reported in the tuberous root (moisture : 84%) whose food value appears to be very low. The herb is also reported to contain the glucoside apiin.

Uses

The leaves and stalks are used as salad and for flavouring soups. The tuberous root is eaten after cooking.

CHERVIL

Bot. Name : *Anthriscus cerefolium* Hoffm.
Family : *Umbelliferae*
Indian Name : *Baz-Atrila.*

Description and Distribution

'Chervil' or 'Salad chervil' is an annual herb 45 to 60 cm high, native to Europe, suited to temperate and higher elevations in the tropics. Its leaves are used both for flavouring salad and as a condiment for garnishing some foods. Its flavour is similar to that of mild parsley and aniseed. The curled-leaf varieties of chervil are the most popular because of their attractive appearance. The leaves are ready for harvesting within 6-8 weeks from seed sowing. The plant is hardy and can withstand winters if given suitable protection. It does not thrive in hot weather.

Composition

Information on its chemical composition is not readily available. Hence the need of attention of chemists and nutritionists.

Uses

Chervil leaves are mainly used for garnishing and flavouring food, their flavour being similar to that of aniseed and parsley. It is chopped fine and sprinkled over fish before removing from the boiler. It is also used in soups, salads, sauces (tarter sauces), egg dishes, French dressing and in a butter sauce for chicken. Chervil is a great favourite in French cuisine where it is used as an alternative to parsley in soup, salads, particularly potato salad, and in the 'Fine Herbes' combination. Dried leaves are used in stuffings. Chervil vinegar is prepared in the same way as 'Tarragon Vinegar' and is used as an alternative to cider-or wine-vinegar in the preparation of salad dressing.

The leaves are reported to be diuretic, stomachic and deoderant. The boiled roots, which have a sweet and aromatic flavour, are eaten.

CHIVES or CIVES

Bot. Name : *Allium schoenoparasum* Linn
Family : *Liliaceae*

Description and Distribution

Chive or Cive, a perennial herb belonging to the onion family, is a native of Europe and adjoining part of Asia. In India, it is grown as a garden crop. Chive is raised in many parts of the world as a vegetable or herb of the home garden, where its small size and great adaptability make it more useful than the common onion. Their tufted habit, attractive green foliage, and purple flowers make them useful as ornamental edging plants or for growth in clumps among other herbs. Chives are completely immune to cold, can withstand drought and grow well in a wide variety of soils. The tops may be cut for use from early spring throughout the summer, and the clumps are easily propagated by division. Few herbs are more attractive, adaptable, or useful for the small garden than chives. Unlike onions, chives have weakly developed bulbs and only their green tops are used. The young, tender, pencil-shaped tubular leaves of this dark green lavender-flowered herb possess a light, delicate onion flavour; and it is among the most popular of culinary seasonings. Cutting of the leaves appears to stimulate the multiplication of plant.

Composition

Little published information is available on this aspect which needs greater attention oi nutritionists and chemists.

Uses

Leaves constitute the main part of the plant and are used principally for flavouring soups, stews, omelettes, cottage cheese, cream cheese and for seasoning salads. Chives are practically always used fresh. However, the dried or powdered leaves of chives are among those used in combination with common salt and other herbs. The fresh leaves are used to flavour all foodstuffs in which a mild onion flavour is desired. The bulbs are pickled as tiny onions, and have an infinitely more delicate flavour. In the USA, chives are specially cultivated for freezing. To maintain high quality in the frozen product, the harvested tops are taken to the processing plant, where they are cooled, washed, cut into small pieces, packaged and frozen as rapidly as possible. The product is inspected several times during processing; sanitary precautions similar to those in modern dairy practice are observed. The frozen product is loose and granular. It is packaged in small plastic cups for home use, and in several sizes of larger containers for commercial use. Dairies, which use chives with cottage cheese, are important commercial purchasers. Most of the output goes to large cities.

CINNAMON

Bot. Name : *Cinnamomum zeylanicum* Blume
Family : *Lauraceae*
Hindi : *Dalchini*, *Darchini*; Bengali, Gujarati, Marathi, Oriya, Punjabi and Urdu : *Dalchini*; Kannada, Malayalam : *Lavang-pattai*; Sanskrit: *Darushila*; Tamil : *Sanna-lavangapattai*.

Description and Distribution

Cinnamon is one of the most important tree spices of India. Like its cousin cassia, cinnamon consists of layers of dried pieces of the inner bark of branches and young shoots from

the evergreen tree *Cinnamomum zeylanicum* which is obtained when the cork and the cortical parenchyma are removed from the 'whole bark'. The thickness of the bark ranges from 0.2 to 1.0 mm. Pure cinnamon is free from any admixture with cassia which is considered inferior to the former in appearance, flavour and odour. As stated earlier, cassia is the commonest substitute of cinnamon. While it may be possible morphologically to distinguish one from the other in the whole form, it is difficult to identify them in the powder form.

The quality of cinnamon depends, among other factors, on the region where it is grown. Sri Lankan cinnamon, and cinnamon from the Seychelles Island are considered to be among the best. In India, it is grown on the west coasts. At Anjarakkandi, Cannanore district, Kerala, there is a 248-acre Randa Tarra cinnamon plantation—one of the biggest and perhaps the oldest plantation in Asia. It also grows on the Western Ghats from south Kanara southwards at low altitudes. Still the quantity of cinnamon produced in the country is not enough as, during 1971-72, cinnamon and cinnamon flower worth about Rs. 1.15 lakh were imported from abroad, in addition to the import of cassia worth another Rs. 3.75 lakhs. Thus there appears to be good scope for extension of area under both cinnamon and cassia in India.

Preparation and curing of bark requires sufficient expertise. The various steps involved are (*i*) cutting of branches of the right size and shape in the right season, at the right stage of maturity; (*ii*) scraping of outer rough corky layer; (*iii*) peeling and skilfully removing the bark from the inner wood; and (*iv*) piping and preparation of quills, quillings, featherings and chips, etc.

Cinnamon is available in the market in different grade designations in different countries, but the more common are the following four accepted by the ISO and ISI that are graded according to their length, breadth and thickness.

(1) Quills : The long compound rolls of bark upto 1 metre in length, which constitutes the best grade.

(2) Quillings : During the course of grading and transportation, some breakage of quills takes place. Besides, the smaller pieces left after the preparation of quills also go into

this second quality cinnamon known as 'quillings'. They are, of course, genuine cinnamon and are mainly used for grinding and also for the distillation of the cinnamon bark oil.

(3) **Featherings** : This grade consists of the inner bark of twigs and twisted shoots which cannot give straight quills or quillings of normal length. Thus they are also genuine and are used in the same way as quillings. However, they often contain small chips.

(4) **Chips** : This classification includes the bark obtained from thick branches and stems, trimmings of the cut shoots before they are peeled, shavings of outer and inner bark which cannot be separated or which are obtained from small twigs by beating or hammering, and odd pieces of outer bark. They invariably contain more or less inferior bark and woody material. This admixture is labelled 'chips' which constitutes the most inferior grade of cinnamon.

Composition

Moisture: 9.9%; protein: 4.6%; fat (ether extract): 2.2%; fibre: 20.3%; carbohydrates: 59.5%; total ash: 3.5%; calcium: 1.6%; phosphorus: 0 05%; iron: 0.004%; sodium: 0.01%; potassium: 0.4%; vitamins (mg/100g): vit.: B_1: 0.14; vit. B_2: 0.21; niacin: 1.9; vit. C: 39.8; vit. A: 175 I.U. per 100g; Calorific Value (food energy): 355 per 100g.

Composition varies according to the quality and region. According to different authors, the following range of variation may be seen—moisture: 5.40-11.4%; volatile oil: 0.3-2.8%; fixed oil: 0.3-1.9%; fibre: 25.6-30.5%; carbohydrates: 16.6-22.6%; protein: 3.0-4.5%; total ash: 3.4-6.0%; ash insoluble in acid: 0.02-0.6%.

Of these, the most important component is the volatile oil of commerce which finds numerous uses as discussed below. Besides, volatile oil is also prepared from cinnamon leaves, fruits and roots as a by-product which too finds use in the trades.

Uses

Cinnamon is a very useful tree. Every part of the tree—bark,

wood, leaves, buds, flowers, fruits and roots—finds some use or the other as indicated below.

Bark : Cinnamon bark primarily is one of the most popular spices in use in every home. It has a delicate fragrance and a warm agreeable taste. It is extensively used as a spice or condiment in the form of small pieces or powder. It is aromatic, astringent, stimulant and carminative and also possesses the property of checking nausea and vomiting. Cinnamon is used for flavouring confectionery, liquors, pharmaceuticals, soaps and dental preparations. Powdered cinnamon is a constituent of chocolate preparations made in Spain. Cinnamon is also used in candy, gum, incense and perfumes.

Bark Oil : Cinnamon bark contains 0.5 to 1.0% volatile oil. The essential oil, generally manufactured in the USA and Europe, is steam distilled mainly from cinnamon chips and refuse left over after the preparation of quills for the spice trade. Bark oil has the following properties : Sp. Gravity at 15.5°C : 1.0150-1.030; Optical Rotation at 20°C: 0 to $-8°$; Refractive Index at 20°C: 1.565-1.599. It is light yellow in colour when freshly distilled and changes to red on storage. It contains cinnamaldehyde 60-75%; eugenol and benzaldehyde, etc. Synthetic cinnamaldehyde and cinnamon leaf oil are the common adulterants for bark oil.

Bark oil is extensively used for flavouring confectionery, liquors, pharmaceuticals, soaps and dental preparations. It has a high germicidal activity (R.W. coefficient, 14.0); but on account of its irritant properties, it is not used as such. It is also a fungicide. It has the cordial and carminative properties of cinnamon without its astringency and is employed as adjuvant in stomachic and carminatives medicine. As a powerful local stimulant, it is sometimes prescribed in gastrodynia, flatulent colic and gastric debility. The dosage is 1-3 minims.

Cinnamon Leaf Oil : Green leaves, on steam distillation, yield 1% essential oil which is generally heavier than water and is aggressive in action. The leaf oil is yellow to yellowish brown with a slight camphoraceous odour resembling that of clove oil. It has Specific Gravity at 15.5°C: 1.045; 1.055 Optical Rotation at 20°C: $-1 = +3°$; Refractive Index at

20°C: 1.530 to 1.548. It contains eugenol 70-95%, cinnamaldehyde and benzyaldehyde, etc.

Cinnamon leaf oil of good quality is being manufactured at Anjarakkandi Plantation, Cannanore district, Kerala.

Cinnamon leaf oil equals clove oil in eugenol content (70-95%) which makes it useful in perfume and flavouring industries. In the USA. the cheaper Seychelles oil is used as a source of eugenol in the synthesis of vanillin, while Ceylon oil, which is considered superior, is employed for perfuming soaps. It is used also for flavouring sweets and confectionery and is a common adulterant for the bark oil. It is used as an embrocation in rheumatism.

Root Bark Oil : The root bark yields 3% oil which differs from both stem-bark and leaf oils. It is a colourless liquid with a camphoraceous odour. It has Specific Gravity : 0.994; (*a*) D: +50°. It contains camphor, pinene, cineole, dipentene, phellandrene, eugenol, safrole, caryophyllene, borneol, and possibly cinnamic and benzoic aldehydes. Camphor separates out on allowing the oil to stand. The oil, however, is not an article of commerce.

Seed Oil : The seeds contain 33% fixed oil, formerly used for making candles. The oil, also called 'cinnamon suet', is obtained by heating to boil crushed ripe fruits suspended in water. The oleaginous matter rises to the surface and solidifies on cooling.

Unripe fruits are sometimes used as adulterant in cloves. A medicinal oil is obtained from the fruits.

Cinnamon Buds are as good for flavouring and spicing as the bark itself.

Wood provides a soft timber for use as low-grade board wood. Timber is moderately soft, not very strong, seasons without difficulty, but warps, splits, cracks, and is liable to strain. It is faintly scented, straight-grained, medium and fairly even textured.

Thus, almost every part of the cinnamon tree is useful in one way or the other.

CLOVE

Bot. Name : *Eugenia caryophyllus* (Spregal) Bullock *et* Harrison
Syn. : Syzygium aromaticum (Merrill *et* Perry)
Family : *Myrtaceae*
Hindi : *Laung*; Bengali : *Lawang*; Gujarati : *Lavang*; Kannada : *Lavanga*; Malayalam : *Grambu*; Marathi : *Luvang*; Oriya : *Labang*; Punjabi : *Laung*; Sanskrit : *Lavanga*; Tamil : *Kirambu, Lavangam*; Telugu : *Lavangalu.*

Description and Distribution

The clove of commerce is the air-dried unopened flower-bud obtained from a handsome, medium-sized, evergreen, straight-trunked tree that grows in Kerala and Tamil Nadu, to a height of 10.7-12 metres.

Clove is the second most important spice of the world, as judged from the world trade, being next only to black pepper. According to an ITC survey the total world exports of clove during 1980 averaged about 35 million dollars (Rs. 34.90 crores) as compared to 241 million dollars (Rs 241 crores) worth of international trade of black pepper. It may be interesting to note that one country alone (Tanzania) supplies about 90% of the total world take-off ! The USA and India are the largest importers of cloves. During 1981-82, India imported over 1.42 lakh kg of exhausted cloves valued at about Rs 36 lakhs and over 8000 kg of unexhausted cloves worth Rs. 2.12 lakhs. In addition, India also imported about 34,000 kg of clove leaf oil valued at Rs 8.5 lakhs. Added to these imports are several aromatic chemicals worth several lakh rupees, derived from its oil. It is therefore, suggested that the area under this highly useful and valuable crop may be extended in India in order to stop the drain of valuable foreign exchange. To attain self-sufficiency, at least 10,000 acres may have to be brought under clove cultivation, the present area covered in India being only 200 acres.

The term 'clove' is derived from the French word 'clov' and the English word 'clout', both meaning 'nail'—from the

likeness of the flower bud of the clove tree to a broad-headed nail.

Clove is one of the most ancient and valuable spices of the Orient, known as far back as the first century before Christ. This spice was later known to the Chinese in 266 B.C. Clove was imported into Europe in 1265. Its source and place of origin were shrouded in mystery until the Portuguese discovered the Moluoca Island in the 16th century. The French succeeded in 1770 in introducing the clove tree into Mauritius and Reunion from where it reached Zanzibar. Clove was established in Sri Lanka in 1796 before the arrival of the British. For some time, clove was a Portuguese and, later, a Dutch monopoly.

In India, clove was introduced in 1800 A.D. by the East India Company. By far the biggest clove-producing region in the world today is Zanzibar, followed by Pemba, Madagascar and Indonesia. Clove is also produced in Malaysia, Sri Lanka and Haiti, but not in commercially significant quantities. The major importers of clove are the USA, India, West Germany and France. Though clove has been under cultivation in India for over 150 years, the acreage under the crop has not gone up to any appreciable extent and the production is not sufficient to meet the requirements of the country. India depends almost totally on foreign countries, notably Zanzibar, for supply of clove, and the import of clove has been steadily increasing from year to year.

The cultivation of clove is largely confined to South India and an area of about 200 acres is estimated to be under this crop, the main growing regions being the Nilgiris, Tenkasi hills and Kanyakumari districts in Tamil Nadu State, and Kottayam and Quilon districts in Kerala State. The long pre-bearing age, lack of scientific knowledge of the culture of the crop, and want of reliable planting material seem to have stood in the way of its large scale cultivation and economic utilisation.

Preparation of Cloves : The fully grown, but unopened buds, are picked green and dried in the sun till they become dark brown, to form the clove of commerce. The buds have a slightly cylindrical base and are surrounded by the plump

ball like unopened corolla which is surrounded by the four-toothed calyx. If the bud is left unpicked, the flower develops after fertilisation into a fleshy, purplish and one-seeded oval fruit known as "Mother of Clove." The fruit is about 2.5 cm long and 1.25 cm wide. The seed is oblong, rather soft in texture and grooved on one side. The leaves, unripe fruit and broken clove including the stalk are all aromatic and yield an essential oil.

The air-dried cloves are graded according to their appearance and level of impurity present. About 8,000-10,000 cloves weigh one kg or 8-10 cloves weigh just one gram. Good quality cloves should be brownish black in colour, with full and plump crown, somewhat rough to touch, without wrinkles and should not contain more than 12% moisture and 2-3% foreign matter (including 'Khoker', 'headless' and 'mother cloves', cloves stems, etc., briefly described below). Yellowish wrinkled cloves are immature and yield volatile oil poorer in eugenol content—the main constituent. They should have fine aroma and flavour, be free from mould and should readily exude oil when their stem is pressed with the finger nail—a layman's test before purchase. This is to make sure at the time of purchase of this valuable spice that one is not cheated with 'exhausted' cloves, i.e., cloves from which essential oil has been removed partially or wholly. Such exhausted cloves do not exude oil when pressed with the nail. One must also be familiar with the following defective cloves.

Khoker Cloves are such cloves as have undergone fermentation due to improper drying. They may be recognised by their pale brown colour and whitish mealy appearance.

Mother Cloves are actually the clove fruits produced as a result of the fertilisation of the opened flower-bud. The fruits are ovoid brown berries surmounted by four incurved sepals. Their length varies from 20 to 25 mm and breadth from 5 to 9 mm.

'Headless Cloves' are the cloves without the ball shaped unopened flower bud at the top. They may or may not have the outer calyx.

Extraneous Matter : One also must look for extraneous matter like dust, dirt, stones, clay particles, clove stems and

other pieces of wood. They should not exceed 2-3% of the total weight.

Composition

The composition of cloves varies somewhat according to the agro-climatic conditions under which it is grown, processed and stored. A typical analysis reveals the following—moisture: 5.4%; protein: 6.3%; volatile oil: 13.2%; non-volatile ether extract (fat): 15.5%; crude fibre: 11.1%; carbohydrates: 57.7%; mineral matter: 5.0%; ash insoluble in HCl: 0.24%; calcium: 0.7%; phosphorus: 0.11%; iron: 0.01%; sodium: 0.25%; potassium: 1.2%; vitamins (mg/100g): vit B_1: 0.11; vit. B_2: 0.04; niacin: 1.5; vit. C: 80.9 and vit. A: 175 I. U.; calorific value (food energy): 430 calories/100g.

The clove buds, stem and leaves, on steam distillation yield essential oils 15-17%, 4.5-5.5% and 1-2% respectively. Their comparative composition and quality are briefly as follows:

Clove Bud Oil: The volatile oil derived from the dried buds by steam distillation contains, as its main constituents, free eugenol (70 to 90%), eugenol acetate and caryophyllene. Although these substances amount to some 99 per cent of the oil, they are not responsible for the characteristic fresh and almost fruity note of pure clove bud oil, which is due to traces of other compounds, the most important one being methyl-n-amyl ketone. A special point of distinction for clove bud oil is that it contains a substantial percentage of eugenol acetate whereas clove stem oil and clove leaf oil contain only traces of it.

Clove Stem Oil: The chemical composition of the oil derived from clove stem has not been investigated as thoroughly as that of the commercially much more important clove bud oil, which is used widely in food products and in pharmaceuticals. In general, the chief constituents present in clove bud oil occur also in the stem oil, but in somewhat different proportions. The percentage of free eugenol present in the stem oil is usually somewhat higher than that present in the bud oil. The stem oil, on the contrary, contains only a small amount of eugenol acetate, whereas the bud oil has been reported to contain upto 17% of this ester. Substances, occurring only in traces, which

impart the characteristic, almost fruity odour to the bud oil, seem to occur in the stem oil in still lesser quantities, or lack entirely, which explains the coarser and 'flatter' odour of the stem oil. On the other hand, clove stem oil contains a few constituents which have not yet been observed in clove bud oil.

Clove Leaf Oil : Clove leaf oil usually contains a somewhat lower percentage of total eugenol than is present in clove bud oil; eugenol acetate occurs in the leaf oil, as in the stem oil, only in very small quantities. The trace substances, methy-n-amyl ketone for example, which impart the characteristic, almost fruity odour to the bud oil, occur in the leaf oil probably even in more minute quantities than in the stem oil; hence the much coarser and 'flatter' odour of the leaf oil. As far as the substances which occur in the stem oil (but not in the bud oil) are concerned, viz. a sesquiterpene alcohol and naphthalene, only the latter (traces) has been observed in clove leaf oil.

Adulteration : Cloves are sometimes adulterated with headless cloves and clove stems which are obtained as 'refuse' while separating the flower stalks in the cluster. They may also be adulterated with Khoker cloves or mother cloves and other extraneous matter like dust, dirt, stones, clay particles and pieces of wood.

The adulterants most difficult to identify in cloves bud oil are clove stem oil and particularly the low-priced clove leaf oil, the addition of which changes the properties of the bud oil only slightly. To prove sophistication with these oils by routine analysis is not easy and, therefore, one must also rely upon organoleptic tests. A real expert will, in most cases, have no difficulty in detecting the presence of leaf oil by its somewhat harsh note.

Another form of adulteration is the additlon of clove terpenes, obtained as by-products in the extraction of eugenol from clove oil. It is difficult to prove the addition of small quantities, but the addition of larger amounts increases the Optical Rotation and lowers the eugenol content, the Specific Gravity, and the Refractive Index of the oil.

Adulteration with synthetic terpineol, dibenzyl, or dibenzyl ether is best detected by the odour on a blotting paper after

standing for a few days, or even better by the odour of the non-phenolic portions of the oil. Acetins, too, are occasionally encountered in commercial clove oils and can be detected by washing the oil with a saturated salt solution. A high saponification number of the water soluble material is indicative of acetins.

Gross adulteration with constituents foreign to clove oil is seldom encountered. A careful study of the odour of the non-phenolic portions of the oil should always be made, if purity is doubtful; a large sample should be freed from eugenol and the remaining non-phenolic portions fractionated in vacuo with a careful examination of each fraction.

The detection of water soluable adulterants can be effected by determining any change in properties before and after washing the oil with saturated salt solutions. The most important test in analysis of clove oil is determination of the total phenols (chiefly eugenol).

Uses

Clove is very aromatic, has a fine flavour and imparts warming qualities. In all Indian homes, it is used as a culinary spice as the flavour blends well with both sweet and savoury dishes. Cloves, both whole and ground, are used in baked goods, cakes, confectionery, chocolate, puddings, desserts, sweets, syrups, preserves, etc. Clove is used for flavouring curries, gravies, pickles, ketchup and sauces, spice mixtures, and pickling spice. It is highly valued in medicine as carminative, aromatic and stimulant. It is also used in flatulence and dyspepsia. Clove has stimulating properties and is one of the ingredients of betelnut chew. In Java, clove is used in the preparation of a special brand of cigarette for smoking.

The essential oil, which is obtained by distilling clove with water or steam, has even more uses. It is used in medicine as an aid to digestion and for its antiseptic and antibiotic properties in tooth-ache. Externally, it has a counter-irritant action. It is an ingredient of many toothpastes and mouth washes. The oil has many industrial applications and is extensively employed in perfumes, in scenting soaps and as clearing agents in histological work. The chief constituent of the oil, eugenol, is

extracted and used as an imitation carnation in perfumes, and for the formation of artificial vanilla.

Oil of clove (derived from the dried buds) represents one of the most important essential oils, indispensable for the flavouring of all kinds of food products (meats, sausages, baked goods, confectioneries, candies, table sauces, pickles, etc.) It is used also for the flavouring of oral preparations (dentrifices, gargles) and chewing gums, etc.

Because of its antiseptic and anti-bacterial properties, numerous pharmaceutical preparations contain oil of clove.

The use of clove oil in perfumes, toilet waters, and soaps of oriental and spicy odour is well known.

The lower-priced oil derived from clove stems, and particularly that from the leaves offers an excellent starting material for the isolation of eugenol, which can be converted into isoeugenol and a very high grade of vanillin. However, vanillin and eugenol are now synthetically prepared.

CORIANDER

Bot. Name : *Coriandrum sativum* Linn.
Family : *Umbelliferae*
Hindi : *Dhania* or *Dhanya*; Bengali : *Dhane*, *Dhania*; Gujarati : *Kothmiri*, *Libdhana*; Kannada : *Kothambri*, *Kothamiri bija*; Kashmiri : *Daaniwal*, *Kothambalari*; Malayalam : *Kothumpalari bija*; Marathi : *Dhana*; Oriya : *Dhania*; Punjabi : *Dhania*; Sanskrit : *Dhanyaka*; Tamil : *Kothamalli*; Telugu : *Dhaniyalu*

Description and Distribution

Coriander seed and fresh coriander (*dhania*) leaves are too well known to need any introduction or description in India, particularly to the housewife, as coriander is used almost daily in scores of curries, etc. Coriander is actually the housewife's secret of tasty dishes. It is a native of Mediterranean region.

India, Morocco, the USSR, Hungary, Poland, Rumania, Czechoslovakia, Guatemala, Mexico and the USA are the important countries where coriander is commercially grown. India produces, on an average, 167,000 tons per year from about 3.5 lakh hectares but has been able to export only about 8,000 tons during 1988-89, valued at only Rs 6 crores.

In India, coriander is cultivated in practically all the States and constitutes an important subsidiary crop in the black cotton soils of Deccan and South India (Andhra Pradesh, Maharashtra, Tamil Nadu), and the rich silt loams of North India (Punjab, Rajasthan, U.P., Himachal Pradesh, Assam, M.P. etc). In Andhra Pradesh and Tamil Nadu, over one lakh acres are under coriander cultivation. Similarly, it is grown on a fairly large scale in Punjab and other neighbouring states. (Annex II and IIA).

Practically all the parts of the plant, that is, tender stem, the leaves, flowers and the fruits have a pleasant aromatic odour. The coriander leaves also constitute one of the richest sources of vitamin C (250 mg/100 g) and vitamin A (5,200 I.U./100g). Its use as a condiment in curries, and particularly as fresh leaves for garnishing of curries and other dishes, and in chutney as an appetizer, should be encouraged.

Composition

Composition of coriander seeds varies, depending upon its country of origin and the agro-climatic conditions under which grown, harvested, dried and stored. The following typical analysis gives a fair idea of its composition—moisture: 6.3%; protein: 1.3%; volatile oil: 0.3%; non-volatile ether extract: 22%; total ether extract (fat): 19.6%; crude fibre: 31.5%; carbohydrates: 24.0%; mineral matter (total ash): 5.3%; acid insoluble ash: 0.20%; calcium: 0.08%; iron : 0.006%; phosphorus: 0.44%; sodium: 0.02%; potassium: 1.2%; vitamins (mg/100 g): vit. B_1: 0.26; vit. B_2: 0.23; niacin: 3.2; vit. C: 12.0; vit. A: 175 I.U./100 g. Coriander seed contains volatile oil, fixed oil, tannins, cellulose, pentosans and pigments.

Coriander leaves (fresh) have the following composition—moisture: 87.9%; protein: 3.3%; fat: 0.6%; carbohydrates: 6.5%; mineral matter (total ash): 1.7%; calcium: 0.14%;

phosphorus : 0.06%; iron : 0.01%; vit. A : 10,460 I U./100 g; niacin: 0.8 mg/100g; vit. B_2 : 60 mg/100g; vit. C : 135 mg/100g.

The aromatic odour and taste of coriander fruits (seeds) is due to an essential oil. The amount of oil varies considerably according to the source of the fruits, Indian coriander being rather poor in oil content (0.4 to 0.8%). The fruits from European countries are usually rich in oil, and samples from test plots in Norway have yielded as much as 1.4-1.7% oil and up to 2% in Russian coriander. The low oil content of Indian coriander is stated to be due to the loss of a portion of the volatile oil during the drying of fruits, too much splitting of fruits, and faulty harvesting procedure of the already inferior variety of coriander.

Indian coriander is not generally preferred for the distillation of essential oil by some Western countries. This is because the Indian seeds are low in essential oil and not uniform in colour and grade. Hence, there is urgent need to evolve new suitable high-yielding, firm (like Russian varieties, not easily breakable), and disease-resistant varieties, rich in essential oil adaptable to the various agro-climatic regions of the country. This is necessary to increase the country's output to meet the internal and external demands. Co-operation and co-ordination between governments, research institutions and farmers are very essential to achieve this objective. By increasing our production, maintaining the seed quality, and thereby keeping our price of coriander on par with that of our competitors in the international market, and by popularising the various uses of coriander listed below, India's export could possibly be increased further.

Volatile Oil : The volatile oil content of the coriander seed varies from 0.1 to 1.7% depending upon the type of seed, soil and climate. Indian coriander oil is a colourless, pale yellow liquid with characteristic odour and taste of coriander and has the following properties—Sp. Gravity at 15°C : 0.8715 to 0.8760; Refractive Index at 25°C : 1.4569-1.4612; Optical Rotation at 25°C: $+10°$ to +1[illegible]°. Considerable variation is observed in the composition of coriander oil from different countries.

The volatile oil is made up of hydrocarbons and oxygenated compounds. The hydrocarbons account for about 20% of the

essential oil. The major oxygenated compounds present are : d-linalool or coriandrol (45-70%). The oil causes irritation when in contact with skin for a long time.

The unripe fruits and other parts of the plant yield small amounts of an inferior oil with a bug-like odour which, however, disappears on keeping, evidently due to the polymerisation of the odoriferous principle.

Fatty Oil : Besides the essential oil, the seeds contain 19-21% of a fatty oil having a dark, brownish green colour and an odour similar to that of coriander oil. The oil has the following characteristics— Sp. gr. 15°: 0.9262-0.9284; Refr. index at 30%C; 1.4704; sap. val: 182-190; iod. val: 93-100; and unsapon, matter: 2.3%. The component insoluble fatty acids are: palmitic: 8%; petroselinic: 53%; oleic: 32%; and linoleic acid: 7%. The oil solidifies on keeping. Sodium soap prepared from the oil has a pleasant odour and good lathering properties. It is soft in consistency and green in colour.

Coriander Herb Oil : Stalks and leaves of coriander yield considerable volatile oil (about 0.1 to 0.95%) but it is absolutely impossible to use the leaf oil instead of seed oil in any flavour, perfume or pharmaceutical formulae. The leaf or herb volatile oil has a pronounced odour of decyldehyde or other higher fatty aldehyde.

Adulteration : Commercial volatile oil is extensively adulterated with sweet orange oil, turpentine, and anethole or aniseed oil, or cedar-wood oil. In flavouring, the coriander volatile oil has the advantage of being more stable and retaining its agreeable odour longer than any other oil of its class.

The commercial product (whole coriander) often contains considerable foreign matter, mostly stalks, dirt, fenugreek, some cereals, and other organic extraneous matter. Ground coriander is prone to greater adulteration than whole seeds.

Uses

The fresh stem, leaves and fruits of coriander have a pleasant aromatic odour. The entire plant, when young, is used in preparing chutneys and sauces, and the leaves are used for flavouring curries and soups. The fruits (seeds) are extensively employed as condiment in the preparation of curry powder,

pickling spices, sausages and seasonings. They are used for flavouring pastry, cookies, buns, cakes, and tobacco products. In the USA and Europe, coriander is employed for flavouring liquor, particularly gin. Coriander seeds are generally used after roasting. Coriander has a mild, distinctive fragrant odour and pleasant aromatic taste, reminiscent of a combination of lemon peel and sage. It is probably one of the first spices to be used by mankind, having been known as early as 5000 B.C., and is one of the important ingredients in the manufacture of the following food flavouring—(*i*) Bakery products, (*ii*) imitation flavour, (*iii*) pork, frankfurter, meat, fish and salads, (*iv*) soda and syrups, (*v*) gelatin dessert and pudding, (*vi*) candy, preserves, (*vii*) liquors.

In Medicine : Coriander seeds are considered to be carminative, diuretic, tonic, stomachic, antibilious, refrigerant and aphrodisiac. They are used chiefly to conceal the odour of other medicines and to correct the griping qualities of rhubarb and senna. The seeds are chewed to correct foul breath. They are also considered to lessen the intoxicating effects of spirituous liquors. An infusion of the seeds in combination with cardamom and caraway seeds is useful in flatulence, indigestion, vomiting and intestinal disorders.

The volatile oil is used chiefly as a flavouring agent for spirituous liquors and in the cocoa and chocolate industries. It is also employed in medicine as a carminative or as a flavouring agent to cover the taste or correct the nauseating or griping qualities of other medicines. It has the advantage of being more stable and of retaining its agreeable odour longer than any other oil of its class.

In Perfumery : Oil of coriander seeds is a valuable ingredient in perfumes; its soft, pleasant, slightly spicy note blends into scents of oriental character. It harmonises well with jasmine, imparting life and lift to otherwise dull or too synthetic compositions. Decyldehyde (0.1% of volatile oil) is also useful in perfumery. Decyldehyde is obtained by treating the volatile oil with bisulphite.

Other Uses : Good quality oleoresin can be extracted from coriander seeds. The oleoresin is used for flavouring beverages, pickles, sweets and other delicacies.

The residue from distillation can be used as a good cattle feed as it is rich in protein and fat.

Soluble Coriander (Superesin) : This is prepared by properly blending and dispersing a minimum of 3% of total extractives of coriander on a soluble, dry edible carrier. The coriander extractives are the sum of the non-volatile ether extract and volatile oil content. The coriander flavouring consists of a maximum of 33% of volatile oil of coriander (vol./wt.), the remainder as the non-volatile ether extract of coriander. The coriander extractives are of good quality and possess the characteristic flavour of good grade coriander. Their flavour is unimpaired in or during the process of extraction.

CUMIN SEED

Bot. Name : *Cuminum cyminum* Linn.
Family : *Umbelliferae*
Hindi: *Jira*, *Zira* or *Safaid Jera* or *Zeera*; Bengali and Punjabi: *Safaid Jira* or *Zeera*; Gujarati: *Jiru* or *Jeeru*; Kannada: *Jeerige*; Kashmiri: *Zyur*; Malayalam: *Jeerakam*; Marathi: *Jeregire*; Oriya: *Jira*, *Jeera*; Sanskrit: *Jiraka*, *Jira*; Sindhi: *Zero*; Tamil: *Ziragum* or *Jeeragum*; Telugu: *Jidakara*, *Jikaka*.

Description and Distribution

Cumin or 'Safaid Zeera' comprises the dried yellowish to greyish brown seeds of a small slender annual herb of the coriander family, believed to be native of Egypt and Syria, Turkestan and the Eastern Mediterranean region. It grows to a height of 30-45 cm and produces a stem with many branches bearing long, finely divided, deep green leaves and small flowers, white or rose in colour, borne in umbels.

The aromatic seed-like fruit, commonly known as 'seed', is elongated, oval, approx. 6 mm long and light yellowish brown in colour, somewhat similar to caraway seed but slightly

longer. The odour is peculiar, strong and heavy, pleasant to some and rather disagreeable to others, while flavour is warm, slightly bitter and somewhat disagreeable.

Cumin is one of the oldest spices, known since Bibilical times. Today, the plant is grown extensively in Iran, India, Morocco, China, Southern Russia, Indonesia, Japan and Turkey. Iran is the major world exporter of the cumin seed known as 'green cumin'. Iran produces about 8,000 to 50,000 tons, depending upon weather conditions.

In India, cumin is cultivated in almost all the states (except Assam, Kerala, and Bengal), notably in U.P., Punjab, Rajasthan, Gujarat and Tamil Nadu in about 77,164 hectares, producing about 35,410 tons of cumin seeds, out of which only about 6405 tons were exported during 1981-82 earning foreign exchange (about Rs. 6.85 crores). Surprisingly enough, we also imported 122.4 tons of cumin (excluding black cumin) from abroad, valued at about Rs 10.85 lakhs. This should be discouraged and instead, India, being now one of the major producers of cumin seed, can definitely lead other producing countries and also stop the drain of foreign exchange, provided high-yielding and disease-resistant varieties, rich in essential oil content, are evolved to suit various agro-climatic regions of the country. By thus increasing our production and by maintaining the seed quality, we can bring our price of cumin on par with those of our world competitors. By further popularising the uses of cumin, India's export could be possibly increased substantially.

Composition

The physico-chemical composition of cumin seeds is as follows—moisture: 6.2%; protein: 17.7%; fat: 23.8%; crude fibre: 9.1%; carbohydrates: 35.5%; mineral matter: 7.7%; calcium: 0.9%; phosphorus: 0 45%; iron: 0.48%; sodium: 0.16%; potassium: 2.1%; vitamins (mg/100g): vit. B_1: 0.73; vit. B_2: 0.38; niacin: 2.5; vit. C: 17.2; vit. A: 175 I.U./100g. Calorific Value: (food energy): 460 calories/100g.

From the commercial quality viewpoint, a summary of analysis of 30 samples of Indian cumin is: moisture: 6 to 10 (av. 7.7%); volatile oil content: 2.5 to 3.6 (av. 3.1%); cold-

water extract: 14.9 to 20.4 (av. 17.5%); total ash: 6.9 to 7.6 (mean 7.3%); acid insoluble ash: 0.2 to 0.8 (av. 0.4%). The exhausted cumin seeds and powder had 0.2-1.2% volatile oil content and very low cold-water extract (3.2 to 4.6% only). Such exhausted cumin seeds find a way in adulteration of the genuine stuff by unscrupulous merchants.

Volatile Oil : The dried fruit is crushed and soon thereafter, it is steam-distilled to yield 2.5 to 4.5% of valuable volatile oil, colourless or pale yellow, turning dark on keeping. The yield of the oil depends upon the quality and age of the seed; the older seeds contain less oil. The range of variations in physico-chemical properties of the oil produced in India and other countries is summarised as follows—Sp. Gravity at 25° C: 0.8923-0.9246 (mean 0.8969); Optical Rotation at 20°C: +3 to + 6° 30' (mean +3°56'); Refractive Index at 20°C : 1.4945-1.5060 (mean 1.4968): Aldehyde content : 32-42% (average 36.30%).

The chief constituent of the oils is cuminaldehyde (20-40%) and is used in perfumery.

Adulteration of Volatile Oil: The most troublesome adulterant is synthetic cuminaldehyde, the presence of which cannot be detected analytically except that there is a rise in the optical rotation.

Fixed Oil : In addition to volatile oil, the seed also contains about 10% fixed (non-volatile) greenish brown oil with a strong aromatic flavour. It is a semi-drying oil having an iodine value of 92.

Uses

Cumin seeds have an aromatic odour and a spicy and somewhat bitter taste. They are largely used as condiment and form an essential ingredient in all mixed spices and curry powders for flavouring soups, pickles and for seasoning breads and cakes. They are also candied.

Cumin seeds have long been considered stimulant, carminative, stomachic, astringent and useful in diarrhoea and dyspepsia. They are now chiefly used in veterinary medicine.

The volatile cumin seed oil is employed advantageously instead of the seed in many types of flavouring compounds, especially in curries and culinary preparations of oriental

character. Because of its powerful odour and flavour, the oil must be used sparingly and most carefully. The oil is used in perfumery and for flavouring liquors and cordials. It is also used as a carminative. The residue left after the extraction of volatile oil contains 17.2% protein and 3% fat. It can be used as cattle fodder.

The fixed oil could also find use in the oil, fat and soap industries.

In Holland and Switzerland, cumin is used to season some kinds of cheese, while in France and Germany, it is used to flavour bread, cakes and pastries. Cumin makes an excellent seasoning of soups and stews, for which it is widely used throughout Latin America. It is also employed in native dishes of Central and South America. Because of this growing popularity of cumin, the demand for Iranian and Indian cumin seed is always on the increase as seen from the exports trends during the past 4-5 years. This happy trend must be maintained.

CUMIN BLACK

Bot. Name : *Nigella sativa* Linn.
Family : *Umbelliferae*
Hindi, Punjabi and Urdu: *Kalunji*, *Kala jira;* Bengali: *Kalijira*; Malayalam: *Karunshiragam*; Marathi: *Kalanjire*; Sanskrit: *Krishna-jiraka*; Tamil: *Karun-jiragam* Telugu: *Nulajilakara*.

Description and Distribution

Black cumin is the dried seed-like fruit of a small herb about 45 cm in height and native of the Levant (eastern Mediterranean region). It is said to be cultivated or occasionally found as a weed of cultivation in Punjab, Himachal Pradesh, Bihar and Assam. Leaves 2.5-3.0 cm long, cut into linear-lanceolate segments; flowers pale blue; seeds trigonous, black, regulose tubercular.

Composition

Analysis of black cumin reveals—total ash 3.8%-5.3%; ash insol-in-acid: 0.0%-0.5%; volatile oil: 0.5%-1.6%; ether extract (crude oil): 35.6%-41.6%; alcoholic acidity as oleic acid (FFA): 3.4%-6.3%.

Volatile Oil: The seeds give on steam distillation, a yellowish brown volatile oil with an unpleasant odour. The oil has the following characteristics—Sp-Gr. at 15°: 0.875-0.886; Refractive Index (20°): 1.4836-1.4844: Optical Rotation 20°: +1.43 to +2.86: Acid value: upto 1.9; Ester value : 1.0 to 31.6; Ester value (after acetylation): 15-73; soluble in 2.0 to 4.5 or more volumes of acohol.

The oil contains carvone (45%-60%), *d*-limonene and cymene. A carbonyl compound, nigellone, which protects guinea pigs against histamine-induced broncho-spasm, has been isolated from the oil. Preliminary clinical trials indicate its possible therapeutic use in some conditions of cough and bronchial asthma.

Fixed Oil : The fatty oil obtained by the expression of seeds is reported to be used for edible purposes. Extraction with benzene and subsequent steam distillation of extract to remove the volatile oil gave about 31% of reddish brown, semi-drying oil with the following characteristics—Sp. gravity 25°: 0.9152; Refractive Index (21°): 1.4662; Acid value: 42.83; Saponification value: 199.6; Iodine value: 117.6; R. M. value : 3.9; Unsaponifiable matter : 0.03%.

Besides the volatile and fatty oils, black cumin seeds contain a bitter principle (nigellin), tannins, resins, proteins, reducing sugars (mostly glucose), saponins and arabic acids. The free amino acids present in dormant seeds are: cystine, lysine, aspartic acid, glutamic acid, alanine, tryptophan, valine and leucine; asparagine is not present.

Uses

The seeds of *N. sativa* are considered carminative, stimulant, diuretic, emenagogue, galactogogue, and are used in the treatment of mild cases of puerperal fever. They are externally applied for skin eruptions. They are also used against scorpion

sting. Alcoholic extracts of the seed show anti-bacterial activity against *Micrococcus pyogenes* var. *aureus* and *Escherichia coli.*

They can be used as a stabilising agent for edible fats.

Seeds are scattered between folds of linen or woollen clothes to preserve them against insect attack.

CURRY LEAF

Bot. Name : *Murraya Koenigii* (Linn) Sprengel.
Family : *Rutaceae*
Hindi : *Kathnim, mitha neem, Kurry patta, Gandhela, Barsanga*; Assamese: *Narsingha, Bisharhari*; Bengali: *Barsanga, Kariaphulli*; Marathi: *Karhinimb, Poospala, Gandla, Jhirang*; Gujarati: *Goranimb, Kadhilimbdo*; Kannada: *Karibevu*; Malayalam: *Kariveppilei*; Oriya: *Barsan, Basango, Bhursunga*; Punjabi: *Curry patia*; Tamil: *Karivempu, Karuveppilei*; Telugu: *Karepaku.*

Description and Distribution

Curry Leaves (*Murraya koenigii* Linn) or 'Curry Patte' are derived from a handsome, aromatic, more or less deciduous shrub (0.9 metre) or a small tree, upto 6 metres in height (in the Himalayan region) and 15-40 cm in diameter, found almost throughout India and the Andaman Islands upto an altitude of 1,500 metres. It is commonly found in forests, often as gregarious undergrowth along the foot of the Himalayas from the Ravi to Sikkim and Assam. It is also found in Bengal, M.P. and in the south and south-western states, namely, Maharashtra, Tamil Nadu, Kerala, and Andhra Pradesh. It is much cultivated for its aromatic leaves and for ornamental value throughout India.

Composition

Moisture: 66.3%; protein: 6.1%; fat (ether extract): 1.0%; carbohydrates: 16.0%; fibre: 6.4%; and iron: 3.1 mg% mineral

matter: 4.2%; calcium: 810 mg; phosphorus: 600 mg; carotene (as vit. A): 12600 I U.; nicotinic acid: 2.3 mg; and vit. C: 4 mg/100g; thiamine and riboflavin absent. The leaves are a fair source of vit. A; they are also a rich source of calcium, but due to presence of oxalic acid in high concentration (total oxalates 1.35%; sol. oxalates 1.15%), its nutritional availability is affected.

The chemical composition of green (fresh) curry leaves at 3 stages of maturity, tender, medium mature and mature leaves determined recently at CFTRI Mysore on moisture-free basis is—protein: 5.44, 6.44 and 7.19%; fat: 3.3, 4.74 and 6.15%; sugar: 14.9, 17.9 and 18.9; starch: 11.4, 14.2 and 14.6%; crude fibre: 5.8, 6.2 and 6.2%; volatile oil: 0.82, 0.55 and 0.48%; acetone extractive (oleoresin): 1.6, 1.4 and 1.3%; total ash (mineral matter): 12.54, 12.7 and 13.1%; and acid insoluble ash: 1.2, 1.3 and 1.35%.

It will thus be seen that with advancing maturity, there was a gradual decrease in volatile oil and oleoresin (acetone extractive) while there was a progressive increase in all other items of analysis. Vacuum-self drying of curry leaves gave a better product of greenish colour than those dried by other methods.

The free amino acids present in the leaves are asparagine, serine, aspartic acid, glutamic acid, threonine, alanine, proline, tyrosine, tryptophan, α-aminobutyric acid, phenylalanine, leucine, isoleucine, traces of lysine, arginine and histidine. The leaves also contain a crystalline glucoside, koenigin, and a resin. Twigs and leaves contain 0.8 percent potash on dry matter basis.

Volatile Oil : Fresh leaves, on steam distillation under pressure (90 lb/sq. in), yield 2.6 percent of a volatile oil which may find use as a fixative for heavy type of soap perfume; distillation at ordinary pressure gives very poor yields of oil, while distillation with superheated steam (temperature 220°) yields a dark-coloured foul-smelling oil. Rectified curry leaf oil is deep yellow in colour with a strong spicy odour and pungent clove-like taste. Essential oil obtained by simple water distillation has the following characteristics—yield: 1%; colour: light yellow; smell : aromatic with spicy note; Sp. Gravity (25°C): 0.8589; Optical Rotation: -36°14; Acid value: 1.17; Sap.

value: 8.18; Sap. value after acetylation: 52.81; The major chemical constituents are—l-sabinene: 34%; l-α-pinene; 27.3%; dipentene: 15 9%; l-Terpenel: 7.7%; l-caryophyllene: 6-7%; l-cadinene: 5.2% and unidentified residue: 3.2%. Thus, further research is needed to have a clear picture of aromatic principles of curry leaves. Using modern techniques, the CFTRI scientists have reported the presence of beta-pinene in curry-leaf oil for the first time.

Uses

As Food Flavourant: The leaves of this plant have been used for centuries in South India as a natural flavouring agent in various curries and chutneys.

In Indigenous Medicine: The leaves, bark and the root of the plant are used in indigenous medicine as a tonic, stomachic, stimulant and carminative. An infusion of the roasted leaves is used to stop vomiting. Externally, they are also used to cure eruptions and the bites of poisonous animals; the green tender leaves are eaten raw for the cure of dysentry. A decoction of leaves is sometimes given with bitters as a febrifuge and the leaves have been claimed to be used with (*Mentha arvensis)* in the form of chutney to check vomiting. It has also been used as an anti-periodic, and many a time, the powdered dry leaf, mixed with honey and juice of betelnut is recommended in the Ayurvedic system of medicine. The leaves, fruits, bark and roots have been reported to contain a glucoside called 'koenigin.' Aqueous extracts of leaves, when administered parenterally to female guinea pigs, not only raise the phagocytic index but also mobilize a greater number of leucocytes to take part in phagocytosis; the effect does not last long. The juice of the root is taken to relieve pain associated with the kidney.

The fruit is edible. It yields 0.76% of a yellow volatile oil with neroli-like odour and pepper-like taste, accompanied by an agreeable sensation of coolness on the tongue.

The wood (43-50 lb/cft) is greyish white, hard, even, close grained, and durable. It is used for agricultural implements.

DILL AND INDIAN DILL (SOWA)

Bot Name : *Anethum sowa* Roxb. ex Flem.
Family *Umbelliferae*
Hindi, Bengali, Punjabi and Urdu: *Sowa*, *Soya;* Gujarati: *Surva*; Kannada: *Sabasige*; Kashmiri: *Soi*; Marathi: *Surva*; *Shepu*; Sanskrit: *Satapushpi;* Tamil: *Sathakuppi sompa;* Telugu: *Sabasige*.

Description and Distribution

The genus *Anethum* comprises 3 species, two of which yield dill oil used in medicine. These two species are:

1. *Anethum graveolens* (European Dill).
2. *Anethum sowa* (Indian Dill).

European Dill is indigenous to Europe and is cultivated in England, Germany, Rumania, Turkey, the USA and the USSR. Till recently, it was not grown in India. However, efforts have been made to acclimatise it in Jammu (RRL work.), New Delhi (IARI work), and RRL, Bhubaneswar (Orissa).

The Indian dill *(A. sowa)* is sometimes regarded as a variety of *A. graveolens*. However, the ripe dried seeds of Indian dill are longer but less broad than those of European dill. Their dorsal ridges are paler in colour. Colour is almost similar, but again they differ in respect of composition of their essential oil as indicated below.

A. sowa is a herbaceous umbelliferous annual with pinnately divided leaves, found practically throughout India. It is also cultivated as a cold weather crop in many parts of India. The ripe, light brown seeds emit an aromatic odour faintly resembling that of caraway. And possess a warm, aromatic and slightly sharp taste almost akin to that of caraway seeds.

Composition

The physico-chemical analysis of 10 commercial samples of Indian dill *(sowa)* seeds in the author's laboratory revealed the following—moisture: 4.5-7.5 (av. 6.2%); volatile oil 1.5 to 4.00 (av. 2.7%); mineral matter (total ash): 5.89 to 11.54

(av. 9.09%); acid-insoluble ash: 0.55 to 2.71 (av. 1.20%); extraneous matter: 3.16 to 12.93 (av. 4.63%); damaged seeds: 0 to 3.05 (av. 0.71%); cut seeds: 0.03 to 0.39 (av. 0.13%); Immature and shrivelled seeds: 3.32 to 15.78 (av. 7.23%).

Composition of seeds of *A. graveolens* (European dill) is—moisture: 6.6%; protein: 13.1%; fat: 17.9%; crude fibre: 20.7%; carbohydrates: 35.7%; mineral matter (total ash): 6.0%; calcium: 1.6%; phosphorus: 0.21%; iron: 0.012%; sodium: 0.01%; potassium: 1.1%; vitamins (mg/100g): vit B_1 0.42; vit. B_2 0.28; niacin: 2.8; vit. C: 12.0; vit A: 175 I.U./100g; Calorific value (food energy): 435 calories/100g.

Essential Oil: On steam distillation, Indian dill yields 1.5 to 4.0% volatile oil, while European dill grown under Indian conditions yields 2.5 to 4.0%. At the IARI, New Delhi, a new selection has been evolved yielding as high as 6.38% essential oil. Such new selections should be encouraged in the country as we are still importing about Rs. 20,000 worth of dill oil from abroad. It should not be difficult to be soon self-sufficient in dill oil by increasing the area under this new selection. The comparative physico-chemical characteristics of the two essential oils are given below:

Physico-Chemical Characteristics	Sowa *(Indian Dill)*	Dill *(European Dill)*
Specific gravity at 20°C	0.9785	0.896
Refractive Index 25°C	1.4943	1.473
Optical Rotation 25°C	47.6°	70°
Carvone content(%)	19.5	45.9

It will thus be seen that the Sp. Gravity and Refractive Index of sowa seed oil are higher while Optical Rotation, Carvone content are lower than those in dill oil. This condition is caused most likely by the presence of a larger quantity of dill-apiole in sowa oil. After removal of this apiole, it approximates in respect of Sp. Gravity and Optical Rotation but not in Carvone content. Part of the sowa seed oil is heavier than water and sinks in the receiver during distillation. This heavier fraction with a boiling point of 230°-285°C,

consists chiefly of dill-apiole which is isomeric with pastey apiole. A recent useful piece of work done in England on the detailed examination of 16 samples of essential oil from dill seeds obtained from England, Germany, India, Rumania, Turkey, the USA and the USSR, by using gas chromatography, revealed that dill-apiole was absent from European dill (even when grown under Indian conditions) and present in Indian oil (sowa) even though grown in Europe, in about twice the weight of carvone.

The method of harvesting and drying significantly affects the yield and quality of the oil. Work at the IARI showed that the yield of oil was 2.88% when seeds were dried in shade but only 1.03% when dried in the sun. Harvesting at the just-ripe stage had higher oil content than over-mature seeds.

The sowa herb yields 0.06% of an essential oil, which has a high proportion of terpenes (-phellandrene), but no carvone. The European and American dill herb oils contain both carvone and d-α -phellandrene, although the carvone content (about 20%) is much lower than that of the seed oil.

Uses

The seeds are well known for their medicinal properties, mostly due to the essential oil in them. Both seeds and oil enter into the composition of various indigenous medicinal preparations. The essential oil, dill oil, or its emulsion in water, 'dill water', is considered to be an aromatic carminative specially useful in the flatulence, colic and hiccups of infants and children.

Dill seeds are used, both whole and ground, as a condiment in soups, salads, processed meats, sausages, spicy table sauces, salads, sauerkraut and particularly in dill pickling. Dill stems and blossom heads are used for dill pickles and for flavouring soups. Ground seed is an ingredient of seasonings. Sometimes, it is used as a substitute for caraway. The green herb is used as a pot-herb and as a flavouring agent. The essential oil is also used in the manufacture of soaps, etc.

The IARI, New Delhi, has developed two patents which

Healthy Cinammon Plant

Drying of freshly prepared Cinammon Quillings

Different grades/types of Cassia/Cinammon in World Trade

A five year old Clove Tree

A new variety of high yielding Coriander richer in essential oil
(Courtesy: CIMAP, CSIR)

Ginger Plantation

employ some of the constituents of *sowa* with minor modifications for use as synergists for insecticides.

The dried residue left after the distillation of the essential oil from the seeds of *A. graveolens* contains fat: 16.8%; protein: 15.1%. It may be used as cattle feed.

FENNEL

Bot. Name : *Foeniculum vulgare* Mill.
Syn : *Foeniculum officinale* All.
Family : *Umbelliferae*
Hindi: *Saunf, Sonp;* Bengali: *Pan-Muhiri, Mauri;* Gujarati: *Variari;* Kannada: *Badi-sopu;* Malayalam: *Perum-jeerakam;* Marathi: *Badi-Shep;* Punjabi: *Saunf;* Sanskrit: *Madhurika;* Tamil: *Shombei;* Telugu: *Sopu, Pedda-jilakara.*

Description and Distribution

The dried, ripe fruit (seed) of cultivated varieties of *Foeniculum vulgare* Mill., fam. Umbelliferae, which is a biennial or perennial, aromatic, stout, glabrous herb, 1.5-1.8 metres high, cultivated in Mediterranean countries, in Romania and in India. The seed is small, oblong, ellipsoidal or cylindrical, 6-7 mm long, straight or slightly curved, and of greenish yellow or yellowish brown colour; Mesco carp is 5-ridged; it possesses an agreeable, sweet aroma resembling aniseed.

Fennel is cultivated mostly as a garden or homeyard crop throughout India at all altitudes up to 1,825 metres. It requires a fairly mild climate and is cultivated as a cold-weather crop in parts of N. India. It does not succeed so well in S. India except at high elevations. It is cultivated in Maharashtra, Gujarat and Belgaum and Dharwar districts in Karnataka, to a small extent in a few western districts of U.P., in small plots in the irrigated areas of Jalandhar, Amritsar, Gurdaspur, Ludhiana, Ferozepur districts of the

Punjab, Karnal district in Haryana and in small patches in Kotah, and Udaipur in Rajasthan.

Varieties: Varieties and races differing in the size, odour and taste of the fruits exist among wild and cultivated fennels, but they are hardly distinguishable from one another: they are regarded as races, varieties or sub-species of *F. vulgare*. The varieties which yield commercially important volatile oils are referred generally to the sub-species *Capillaceum* and placed under two distinct varieties, (i) var. *vulgare* (Mill.) Thellung (cultivated or wild, yielding Bitter Fennel Oil) and (ii) var. *dulce* (Mill.) Thellung (cultivated, yielding Sweet or Roman or Florence Fennel Oil). Var. *vulgare* is cultivated chiefly in Russia, Hungary, Germany, France, Italy, India, Japan, Argentina and USA. The cultivation of var. *dulce* is confined to France, Italy and Macedonia in southern Europe. Indian fennel is sometimes regarded as a distinct variety, var *panmorium* (syn. *F. panmorium*).

Further, considerable research work has been conducted at the IARI, New Delhi, on the selection of high essential oil yielding and high seed yielding varieties. Recently, Gujarat Agricultural University, Ahmedabad, has evolved a new fennel variety (PF35) which is claimed to yield about 2000 kg/ha. i.e. 16-22% higher than the existing commercial varieties. Such varieties should be given a fair trial by fennel growers.

Fennel fruits (seeds as they are known in commerce) are classified for trade purposes according to their place of origin. Some of the well-known types in India are Bombay, Bihar and U.P. fennels; seeds from Lucknow are considered to be the best and are priced higher than those from other areas. Commercial samples vary considerably in quality, depending upon the variety or race to which they belong and the care bestowed in harvesting and storing the fruits. They often contain sand, stem tissue, stalks and other umbelliferous seeds. They are sometimes adulterated with exhausted or partially exhausted fruits or with undeveloped or mould-attacked fruits. There is also some confusion between the seeds of fennel and those of anise (*Pimpinella anisum* Linn.), though typical samples of each have distinctive features and flavours.

Fennel fruits produced in india are largely consumed within

the country. During 1981-82, only 1033 tons of seeds worth about Rs. 89 lakhs were exported. The chief importing countries are Pakistan, Sri Lanka, Burma, Malaysia, Straits Settlements, Kenya, Sweden, UK, France and the USA.

Composition

Moisture: 6.30%; protein: 9.5%; fat: 10%; crude fibre: 18.5%; carbohydrates: 42.3%; mineral matter: 13.4%; calcium: 1.3%; phosphorus: 0.48%; iron: 0.01%; sodium: 0.09%; potassium: 1.7%; vitamins (mg/100g)—vit. B_1: 9.41; vit. B_2: 0.36; niacin: 6.0; vit. C: 12.0; vit. A: 1040 I.U./100g; Calorific Value (food energy): 370 calories per 100g.

Volatile Oil: On steam distillation of crushed fennel seed, volatile oil (0.7-6.0% is obtained. The percentage of oil varies considerably, being the lowest in fruits of Indian origin (0.7-1.2%) and highest in fruits from Eastern Europe (4.6%). The essential oil of fennel seed is a colourless or pale yellow liquid with a characteristic taste and odour. Two types of oil are recognised in commerce—sweet fennel oil from the fruits of var. *dulce* and bitter fennel oil from the fruits of var. *vulgare*. The taste and odour of sweet fennel oil are superior to those of bitter oil. The characteristics of Indian fennel seed oil are: Sp. gravity at 15° : 0.9744-0.9767; Optical Rotation : 11° 42'-16° 54'; Refractive Index : 1.5355-1.5363. The constants of Indian fennel oil lie within the limits of commercial fennel oils. The composition of the oil varies widely according to the variety or race from which the oil has been distilled and according to the region of origin. Indian fennel oil contains over 70% anethole and 6% fenchone. It possesses a sweet taste.

The main constituent of the oil from the fruits of cultivated *F. vulgare* is anethole. Oils of good quality contain 50-70% anethole.

The oil of Sweet or Roman fennel fruits contains: anethole, d-phellandrene and d-limonene. The high percentage of anethole (upto 90%) and the absence of fenchone are responsible for its delicate sweet odour and flavour. Terpeneless fennel oil is obtained by removing terpenes from sweet fennel oil.

The volatile oil distilled from the above ground parts of

wild-growing bitter fennel plants, has the following constants —Sp. Gr. 15°: 0.873-0.925; (a)+40°0' to +68°0; n20°: 1.484-1.508; soluble in 0.5-1 vol. of 90% alcohol, sometimes with opalescence. It contains little, if any, anethole, the chief ingredient being d-α-phellandrene. The oil has not found any commercial application.

Fixed oil: Fennel seeds also contain 9.0-13% fixed oil which has the following constants—Specific Gravity 15°: 0.9304; n35°: 1.4795; Sap. val : 181.2; Iod. val. (Wijs): 99; Unsapon. matter: 3.68% and sol. pt.:—2°. The component fatty acids of the oil are—palmitic: 4; oleic: 22; linoleic: 14; and petroselinic acid: 60%.

Uses

The plant is pleasantly aromatic and is used as a pot-herb. The leaves are used in fish sauce and for garnishing; leaf stalks are used in salad. Thickened leaf stalks of Florence fennel are blanched and used as vegetable. The leaves are reported to have diuretic properties. The roots are regarded as purgative; they have an aromatic odour and taste.

Dried fruits of fennel have a fragrant odour and a pleasant aromatic taste. In India and the neighbouring countries, they are used as a masticatory or for chewing alone or in paans. They are used for flavouring soups, meat-dishes and sauces, bread-rolls, pastries and confectionery, liquors, and in the manufacture of pickles.

The fruits are aromatic, stimulant and carminative. They are official in the pharmacopoeias of all countries and are considered useful in diseases of the chest, spleen and kidney. They are employed also as a corrective for less pleasant drugs particularly senna and rhubarb. Fennel is a constituent of liquorice powder and of preparations for allaying griping. An infusion prepared with 8-12g of fruits in 500 cc of boiling water is employed as an enema for infants for the expulsion of flatus. A hot infusion of the fruits is used in indigenous medicine to increase lacteal secretion and to stimulate sweating.

During World War II, fennel oil was utilised in place of anise oil as a source of anethole. It is aromatic and is mildly carminative. It is useful in infantile colic and flatulence. It

checks griping in purgatives and is considered a good vermicide against hookworm in doses of 60 minims. It is employed as a corrective for medicinal preparations with less pleasant flavour and odour and enters into the composition of 'Fennel Water' used medicinally as a vehicle for drugs. It is not much used in perfumery, though occasionally employed in scenting soaps.

The residue left after the distillation of essential oil from the fruits is used as a feed for cattle. It contains 14-22% proteins and 12-18.5% fat.

FENUGREEK

Bot. Name : *Trigonella foenum-graecum* Linn.
Family : *Leguminosae*
Hindi, Bengali, Gujarati, Marathi, Oriya, Punjabi, Sanskrit and Urdu : *Methi*; Kannada : *Menthya*; Malayalam : *Ventayan, Uluva*; Tamil : *Vendayam* or *Venthiyam*; Telugu : *Mentulu* or *Menthulu.*

Description and Distribution

Fenugreek is the dried ripe fruit of an annual herb, native of south-eastern Europe and West Asia and now cultivated in India, Argentina, Egypt and Mediterranean countries (southern France, Morocco and Lebanon). The seed is small and yellowish brown in colour. It has a pleasantly bitter taste and a peculiar odour and flavour of its own.

The seed is produced as a spice, as a vegetable for human consumption, as forage for cattle and, to some extent, for medicinal purposes. This robust herb has light green leaves, is 30 to 60 cm tall, and produces slender beaked pods 10 to 15 cm long. Each pod contains 10 to 20 small hard yellowish brown seeds, which are smooth and oblong, about 3 mm long; each is groved across one corner, giving it a hooked appearance.

India is one of the major producers and exporters of fenugreek. There are about 40,000 hectares under fenugreek in India, yielding about 20,000 tons, of which only 3,100-4,000 tons are exported annually (foreign exchange earning, Rs. 1.3 to 1.7 crores). This spice occupies third place in area and fourth in production among all minor spices grown in this country. India being the world's major producer of the major spices, can also overtake other countries producing and exporting fenugreek provided we evolve high-yielding and disease-resistant varieties suited to our various agro-climatic regions. It is very essential to carry out scientific and technological research on this important minor spice of our country.

Composition

Moisture : 6.3%; protein : 9.5%; fat : 10.0%; crude fibre : 18.5%; carbohydrates : 42 3%; ash : 13.4%; calcium : 1.3%; phosphorus : 0.48%; iron: 0.011%; sodium : 0.09%; potassium: 1.7%; vitamins—vit. A : 1040 I.U./100 g; vit. B_1 : 0.41 mg/100; vit. B_2 : 0.36; vit. C : 12.0 and niacin : 6.0 mg/100g. Calorific value (food energy) : 370 calories/100g.

According to another source, fenugreek seed also contains gums (23.06%): mucilage (28.00%).

At CFTRI, Mysore, recent systematic analysis of 24 samples of fenugreek drawn from different regions showed the following variations—moisture : 7-11% (av. 8.7%); crude protein : 27.7-38.6% (av. 31.6%); mineral matter (total ash) : 3.35-6.80% (av. 4.9%); acid insoluble ash : 0.2-2.3% (av. 1.0%); pet. ether extract : 5.2-8.2% (av. 6.3%); alcohol extract : 16.6-24.8%); (av. 20.4%); hot water extract : 29-39.7% (av. 34.0%). Thus alcohol is able to extract about twice the quantity of oleoresin as that with pet. ether. Fenugreek seeds are a very good source of protein.

In a nutshell, fenugreek seed contains many substances like protein, starch, sugars, mucilage, mineral matter, volatile oil, fixed oil, vitamins and enzymes. Seeds are rich in essential amino acids.

Fenugreek leaves and stems are also rich in calcium, iron, carotene (vit. A) and ascorbic acid. Although fresh leaves

contain only 3-5% protein, on dry-weight basis, they are comparable to pulses.

Fixed Oil : The fixed oil content is about 7%. The fatty acids consist largely of linoletic, oleic and linolenic acids. It has marked drying properties, the dried oil being golden yellow in colour and insoluble in ether. The oil has a disagreeable odour and bitter taste.

Volatile Oil : The volatile oil content of fenugreek is very small, less than 0.02%. It is brown in colour and slightly odorous. Its specific gravity is stated to be 0.871 at 15.5°C. Very little is known of its chemical composition. It is not of any commercial importance.

Effect of Roasting and Cooking on Nutritive Value : The loss of ascorbic acid is the least in pressure cooking and greatest in stirfrying of vegetable fenugreek. The loss of ascorbic acid is more at room temperature than in the refrigerator. Raw dry fenugreek seeds contain about 150 mg of trigonelline and practically no nicotinic acid. If the seeds are roasted sufficiently to brown them slightly, about 2/3 of the trigonelline is converted into niacin or nicotinic acid (vitamin). An increase in free and total niacin has been noted when fenugreek seeds are roasted in a shallow pan over an open fire. Seeds were used in the typical preparation of Indian and Egyptian foods. Some foods were prepared with fermented dough. In every case there was an increase in total and free niacin after cooking. The addition of 5% fenugreek to corn results in a 30-35% increase in free niacin in the cooked products. Fermentation resulted in a significant increase in both free and total niacin.

CFTRI scientists have found that fenugreek seeds when roasted at 150°, 175° and 200°C showed that light roasted (150°C) seeds were superior to the medium (175°) and dark roasted (200°C) seeds with regard to flavour and nutritive value. No appreciable loss in total nitrogen and crude protein was noticed during roasting, but there was a considerable decrease in total and free sugars as the temperature of roasting was increased. Out of the 5 reducing sugars and 3 non-reducing sugars, 3 reducing sugars were completely lost. However, roasting of seeds significantly improved the flavour of the seeds. More research is needed on further chemical changes that take

place during roasting, particularly with respect to alkaloid and niacin.

The vitamin C content of raw fenugreek leaves averages 43.10 mg/100g. After boiling in water, steaming and frying, the vegetable loses 10.8% and 7.4% of the vitamin respectively. Results of organoleptic evaluation showed that the most acceptable method of preparation is by steaming.

Uses

As Food or Food Flavourant : Fenugreek has been used both as a food or food additive as well as in medicine. Fresh tender pods, leaves and shoots which are rich in iron, calcium, protein, vitamin A and vitamin C, are eaten as curried vegetable since ancient times in India, Egypt, etc. As a spice, fenugreek also adds to the nutritive value and flavour of foods. Because of this, fenugreek is of considerable importance in those countries in the Middle and Far East where meatless diets are customary for cultural and religious reasons.

In Egypt and Ethiopia, fenugreek is a popular ingredient of bread, known to the Arabs as 'hulba', and in Ethiopia going by the Amharic name 'abish'. In Greece, the seeds, boiled or raw, are eaten with honey. In the United States, it is used in the manufacture of chutneys and in various spice blends, but its most important culinary use is as a source of fenugreek extract, the principal flavouring ingredient of imitation maple syrup. It is used in recipes like Hearty Vegetable Bean Soup and Fenugreek Beef Stew.

Fenugreek is mainly of interest as one of the principal odorous constituents of curry powder.

In Medicine : Medical papyri from ancient Egyptian tombs reveal that it was used both to reduce fevers and also as a food. According to the belief of the ancients, fenugreek stimulates the digestive process as well as the metabolism in general. The seeds are used in colic flatulence, dysentery, diarrahoea, dyspepsia with loss of appetite, chronic cough, dropsy, enlargement of liver and spleen, rickets, gout, and diabetes. The seeds are used as carminative, tonic, aphrodisiac; and infusion given to small pox patients as a cooling drink;

roasted and then infused, used in sweets served to ladies during the post-natal period.

Although the use of most spices in medicine has declined substantially in recent years, fenugreek is an important exception to the rule. Recent studies in England indicated that fenugreek seeds substantially contain the steroidal substance diosgenin which is used as a starting material in the synthesis of sex hormones and oral contraceptives. Diosgenin is at present obtained mainly from the tubers of certain species of Dioscorea grown in Mexico and Central America. This is a large duration and costly crop whereas fenugreek is a short duration and non-expensive crop. If plant breeders are successful in developing fenugreek varieties with a high content of diosgenin, this little-known spice could make a two-fold economic contribution to a solution of the world's population problems by assisting in birth control and at the same time providing additional food. Also, the seed is used by Indian women for its power to promote lactation.

As Cattle-Food, Veterinary Medicine: Ground fine and mixed with cotton seed, it is fed to cows to increase the flow of milk. Mildewed or sour hay is made palatable to cattle when fenugreek herbage is mixed with it. It is also used in veterinary medicinal preparations. It is used as a conditioning powder to produce a glossy coat on horses.

In Cosmetics: Indeed in the Middle Ages, fenugreek was recommended as a cure for baldness in men. In Java today it is used in hair tonic preparations and as a cosmetic. The powder made from the seeds is used in the Far East as a yellowish dye. Harem women in North Africa and the Middle East roasted fenugreek seeds to achieve a captivating buxom plumpness! The fenugreek seeds contain a fixed oil which has an overpowering celery-like odour that is extremely tenacious and, in recent years, has attracted the interest of the perfume trade.

GALANGAL

Bot. Name : *Alpinia galanga* (Linn) Willd.
Family : *Zingiberaceae*
Hindi and Bengali: *Kulanjan;* Gujarati: *Kolinjan;* Kannada: *Rasmi, Sugandha vachi;* Malayalam: *Aratta* or *Perasatta;* Marathi: *Baripankijar, Koshikulinjan;* Punjabi: *Kulanjan;* Sanskrit: *Kulanja, Kulanjana;* Sindhi: *Kathi, Kunjar;* Tamil: *Sungandam Tittiram;* Telugu: *Pedadumparashtram, Kachoramu;* Urdu: *Kulanjan.*

Description and Distribution

Galangal is the dried rhizome or root of a plant *(A. galanga)* Willd. which grows mainly in the eastern Himalayas and south-west India. The plant is 1.8-2.1 metres high, and bears perennial rhizomes which are deep orange-brown in colour, aromatic, pungent and bitter. The fruits are about 13 mm long, constricted in the middle and contain 3-6 seeds. The latter are slightly pungent, with an aroma similar to that of the rhizome. Cut pieces of the rhizome of this species are know as 'greater galangal'. The rhizome of 'lesser galangal' is smaller and reddish brown in colour, and has a stronger odour and taste. According to Guenther, galangal root is also known under the names of 'smaller galangal' and 'Radix galangal minoris.'

The earliest reference to this spice is that of an Arabian geographer Ibn Khurdabah (869-885 A.D.) who included galangal in a list of products from a country he refers to as Sila, which was undoubtedly China. Sometime later, Plutarch made reference to the use of galangal as a fumigating spice by the early Egyptians. In 1153, it was mentioned by Edrisi as an incoming spice into Aden, which was then the port used by the Egyptians for all Asiatic produce. In his travels, Marco Polo mentions that it was produced fairly extensively at Kachanfu and at Kinsai (Tonkin).

Galangal is one of the spices which reached the European markets relatively early, for it is mentioned along with pepper

in the literature of the Middle Ages where it received praise in various writings dealing with drugs, medicines, etc.

The source of the spice which was reaching the European market remained almost unknown until the last century when, in 1867, a plant of unknown botanical origin was discovered in the extreme south of China. The following year, Hance examined both dried and living specimens of the plant and was able to conclude that it was the same as the 'lesser galangal' known to the pharmacists.

Composition

Little published information on its composition or nutritive value is available. However, some useful information is available on its volatile oil.

Volatile Oil: Galangal oil, which is also known as 'false ginger oil,' 'lesser galangal oil' and sometimes as 'Chinese galangal oil,' is a steam-distilled oil from the dried comminuted rhizomes of galangal. Galangal oil is a pale yellow to olive-brown liquid with an eucalyptus-cardamom-ginger-like odour and warming camphoraceous-like bitter taste.

The green rhizomes contain 0.04% essential oil, sp. gr. at (d/19°, 0.978-0.985; Opt. Rot. + 4.6°; nD, 1.5164; Ester val., 145.6). It consists of methyl-cinnamate (48%), cineol (20-30%) some camphor, and probably d-pinene. Leaves also yield a volatile oil.

There is variation in composition of rhizome oil as reported by different scientists, which is naturally due to the variance in the volatile oil itself, the composition of which in turn is affected by a number of factors such as (i) area of cultivation, (ii) age of the plant, (iii) season and climatic conditions, (iv) type of soil, (v) time of harvest, and (vi) method of distillation, etc.

Uses

In indigenous medicine, the rhizomes are used in rheumatism and catarrhal affections, specially in bronchial catarrh. The drug is a depressant of the cardio-vascular system. Respiration in experimental animals is stimulated by small doses but depressed by larger ones. It has important action on the

bronchioles. The rhizome and its essential oil are useful in respiratory troubles, specially of children. The rhizomes are also carminative and stomachic. In Malaysia, they are used as spice, and the fruits as substitutes for cardamoms.

Galangal oil is used as a trace constituent in flavour studies but is rarely used in perfumery. It could, however, be of value in an oriental or spice-type perfume formulation.

GARLIC

Bot. Name : *Allium sativum* Linn.
Family : *Lilliaceae*
Hindi: *Lasum*, *Lassan*, *Lahsun;* Assamese: *Naharu;* Bengali: *Rashum;* Gujarati: *Lasan;* Kannada: *Bellulli;* Kashmiri: *Ruhan;* Malayalam: *Vellulli;* Marathi: *Lusoon;* Oriya: *Rasuna;* Punjabi: *Lassan*, *Lasum;* Sanskrit: *Lashuna;* Tamil: *Ullipundu*, *Vellaip-pundu;* Telugu: *Velluri*; Urdu: *Lessun*, *Lashun.*

Description and Distribution

Garlic or *Lassan* needs no introduction since it has long been recognised all over the world as a valuable condiment for foods, and a popular remedy or medicine for various ailments and physiological disorders.

Garlic has since long been cultivated practically throughout India as an important minor spice or condiment crop. The acreage under garlic as an irrigated crop is reported to exceed 57,000 hectares in India. However, reliable state-wise statistics on acreage and production are available in Annexure II. It is desirable that a central co-ordinating agency/department be set up for collecting, collating and projection of annual progress in production. However, during the past two years, garlic bulbs, dehydrated garlic and garlic powder worth about Rs 26 to 29 lakhs were exported from India to several countries.

There is ample scope for exports and for increasing the area under garlic which is such a valuable crop.

It is a hardy bulbous perennial with narrow flat leaves, and bears small white flowers and bulbils. The bulb consists of 6-30 smaller bulblets called 'cloves' and is surrounded by a thin white, or pinkish papery sheath. Garlic has a stronger flavour than onion or its other allies. Recovery of cloves is 86-96% (average 93.7%).

Garlic grows under much the same conditions as the onion, except that it favours a richer soil and a higher elevation (900-1200 metres). A well-drained, moderately clayey loam is best suited for its cultivation. It requires a cool moist period during growth and a relatively dry period during the maturing of crop. It takes longer (4-5 months) than onion to mature, and is consequently grown as a late season irrigated crop. In South India, it is rotated with *ragi* (*Eleusine coracana*), chillies, maize, potatoes and beans.

Varieties : No distinct varieties of garlic are recognised by the trade in North India but two distinct types, namely *Fawari* and *Rajalle Gaddi* with slightly bigger bulbs are grown in the Bellary district of South India. Breeding for production of new varieties with large bulbs of white colour, uniform shape and size, bold and compact cloves, high yield and resistance to diseases and pests, is under way at the Punjab Agricultural University, Ludhiana.

During the course of the development of a patented process at CFTRI, Mysore, for the economic manufacture of garlic powder from Indian garlic, the author had the unique opportunity of testing garlic grown in important States of India and observed that Jamnagar garlic was the biggest and the best, giving the highest recovery of dehydrated peeled garlic and garlic powder of good pungency and antibacterial activity.

The crop is ready for harvesting when the tops turn yellowish or brownish, and show signs of drying up, usually about a month or so after the emergence of seed stalks. The bulbs are lifted, freed from earth and the leaves tied at the top. The bulbs are cured for three to four days in the shade before storing them in an ordinary room. Tops are removed before

marketing the produce. Thoroughly cured garlic bulbs keep fairly well in ordinary well-ventilated room/store.

Composition

Fresh peeled garlic cloves (bulblets) have the following composition—moisture : 62.8%; protein : 6.3%; fat : 0.1%; mineral matter : 1.0%; fibre : 0.8%; carbohydrates : 29.0%; calcium : 0.03%; phosphorus: 0.31%; iron (Fe) : 0.001%; Calorific Value (food energy) : 142 calories/100 g.; vit. A : 0, nicotinic acid : 0.4 mg/100g; vit. C : 13 mg/100 g.

Garlic Powder (Dehydrated garlic) has the following nutritive value—moisture : 5.2%; protein : 17.5%; fat : 0.6%; mineral matter : 3.2%; fibre : 1.9%; carbohydrates : 71.4%; calcium : 0.1%; phosphorus 0.42%; iron : 0.004%; sodium : 0.01%; potassium : 1.1%; vit A : 175 I.U./100g; vit. B_1: 0.68; vit. B_2 : 0 08; niacin : 0.7%; vit. C : 12.0 mg/100g, and Calorific Value (food energy) : 380 calories per 100g.

The author and his associates have published a series of 12 papers on garlic powder according to which the following additional information is available. Anti-bacterial activity : 15-31 mm (by cup-plate method) : allyl sulphide : 0.57 to 2.70%; total sulphur : 594-834 mg/100g; volatile oil : 0.04-0.1% alcohol extract : 7.22%; non-volatile extract : 6.20%; volatile ether extract : 0.10%; starch : nil; total ash : 3.46%, water soluble ash : 3.4%; acid insoluble ash : nil; total bacterial load : 50×10^4/g. We also succeeded in preparing odourless garlic powder by inactivating the enzyme allinase. It had almost the same composition as that of garlic powder except in respect of allicin, the pungent principle, which could be regenerated at will by either incorporation of fresh enzyme or fresh crushed garlic in small quantity.

Garlic Salt is prepared by mixing rapidly garlic powder : 20 parts; refined pulverised salt : 78 parts; and anti-caking agent (usually calcium stearate or equivalent): 2 parts; total, 100 parts. Accordingly, the composition will be in proportion to the garlic powder used. However, the major points of difference would be: total ash : 82.32%; water soluble ash : 78.43%; ash insoluble in acid : 1.04%. The higher ash and water soluble ash values are due to the added 78% common salt and higher

acid insoluble ash due to the added calcium stearate (anti-caking agent.)

Garlic Powder : The author and his associates have developed a patented technique at CFTRI, which, apart from being very economical, yields a powder of better colour, flavour and pharmaceutical value or anti-bacterial activity. It has the following advantages : (1) About 20% of the fresh crop is wasted due to respiration, transpiration and micro-biological spoilage on account of storage and transport facilities. Thus, if the surplus crop could be conveniently and economically channelled into the production of garlic powder by this improved technique, a considerable national waste could be avoided. Incidentally, this will also assist in regularising the market rates, particularly in the glut season. (2) All undersized or cull but healthy bulbs, which normally fetch very low price in the market, could be conveniently utilised in the manufacture of garlic power with advantage. (3) Given the necessary publicity, garlic powder should prove very handy to the housewife for day-to-day use both as condiment and as folk medicine. It could also save her the botheration of peeling garlic everyday and also save time. (4) A cheap garlic powder of good overall quality could be most welcome to the food industry in the country for flavouring several food products. (5) Garlic powder converted into suitable tablets or packed into capsules should find a ready market in this country, in the face of costly synthetic tablets claiming anti-bacterial activity. (6) It also has bright future possibilities for export purposes.

Uses

Garlic has since long been recognised all over the world as a valuable condiment for foods, and a popular remedy for various ailments and physiological disorders. According to the Unani and Ayurvedic systems as practised in India, garlic is carminative and is a gastric stimulant, and thus aids in digestion and absorption of food. It is also given in flatulence. In modern allopathy, it is being used in a number of patented medicines and other preparations. Besides, garlic is also anthelmintic and antiseptic. The active principle in garlic is

an antibiotic—allicin, which is an enzymatic clevage product from its precursor, 'allin', naturally present in garlic.

The anti-bacterial action of garlic had been noticed from early days, its healing capacity and effectiveness against cholera having been recorded as early as 1758. Besides, its anti-bacterial action against *Eberthella typhosa*, *Escherichiacoli*, Acid fast bacilli, *Aerobacter aerogenes*, *Staphylococcus aureus* and *Shigella sonnei*, various gram-positive and gram-negative organisms in dilutions as low as 1:85000 to 1:125000 and its ineffectiveness against *L. caseii* and *S. faecalis* have been experimentally demonstrated. Further, 1 mg of allicin has been reported to correspond to 15 Oxford units of penicillin. Preparation of several odourless garlic preparations has also been reported. The author and his associates have recently reported the stability of the active principle (allicin) in garlic during dehydration and subsequent storage in different containers at different temperatures.

Garlic as Condiment : Garlic is used practically all over the world for flavouring various dishes. In America, about 50% of the entire output of fresh garlic is dehydrated and sold to food processors for use in mayonnaise products, salad dressings, tomato products and in several meat preparations. Further, raw garlic can be used in the manufacture of garlic powder, garlic salt, garlic vinegar, garlic cheese croutins, garlicked potato chips, garlic bread, garlicked meat-tit-bits and garlicked bacon, etc., which have been boosted in the American market. Recently, spray-dried garlic products have also been put in to the market, though liquid garlic preparations have also been available for some years.

In Italy, Europe, and particularly in Latin American countries, spectacular popularity of garlic is shown by the methods by which it is boosted by the garlic growers.

In India and other Asian and Middle East countries, it is already being used in several food preparations notably in chutneys, pickles, curry powders, curried vegetables, meat preparations, tomato ketchup and the like. Of recent, there has been considerable demand by the food industries in this country for garlic powder as a condiment.

Recently, studies conducted at the Bhabha Atomic Research

Centre, Bombay, on differential toxicity of garlic oil to housefly and khapra beetle indicated that adults as well as the larvae of both the species respond to the vapours of garlic oil by exhibiting hyper-excitability, ataxia, salivation and excretion, the usual signs of poisoning when treated similarly with insecticides. Thus, garlic oil is considered to be an effective insecticide, The larvicidal principles of garlic have been isolated and identified as 'diallyl disulphide' and 'diallyl trisulphide' which are fatal at 5 parts per million to larvae of *Culex pipiens quinquefasciatus* Say.

Oil of garlic has lately come to be appreciated as a valuable flavouring agent, for use in all kinds of meat preparations, soups, canned foods and sauces.

According to an American patent, the residue of garlic, obtained by alcoholic extraction and distillation, contains a bacteriostatic and bactericidal substance identified as 'allyl disulfide oxide'.

On steam distillation of crushed garlic at atmospheric pressure, the major odour producing principle allicin is decomposed down to diallyl disulphide and other disulphides. That explains why the volatile oil of garlic consists chiefly of disulphides. However, allicin can be isloted by steam distillation at reduced pressure. It may also be clarified that the mother precursor allin does not possess bactericidal properties. It is only allicin produced as a result of enzymic cleavage of allin which is bactericidal.

The inhalation of garlic oil or garlic juice has been recommended in cases of pulmonary tuberculosis, rheumatism, ster lity and impotence.

Garlic juice is used for various ailments of the stomach, as a rubefacient in skin diseases, and as ear drops in ear-ache. The juice diluted with water can be used against duodenal ulcers. In Cambodia, the leaves are used in the treatment of asthma.

Because of its highly curative properties, it has been described as derived from *Amrita* or *Ambrosia*. The later prejudice against the use of garlic in India, particularly among the Brahmins, appears to have originated from its popularity with the foreign invaders. The prejudice became so intense that not

only socio-religious writers like Manu deprecated its use, but also the authors of medicine like Kashyapa disparaged it. The recent scientific evidence about its several highly curative properties clearly shows that the old prejudice was not justified. It is one of the cheapest and most efficient folk medicines in the hands of the housewife and the layman alike for day-today use which should be encouraged.

Recent scientific tests on rabbits proved that garlic inhibited, to a certain degree, the development of extremely severe forms of experimental hypercholestrinaemia. In an acute experiment on 75 cats, garlic fractions displayed a considerable hypotensive effect. In dogs, with experimental hypertension, garlic reduced their systolic arterial tension to values nearly as high as the normal ones.

Clinical application of garlic in 114 human patients with a clear cut hypertension and atherosclerosis, markedly improved their complaints and in the overwhelming majority, provoked a drop of their systolic arterial tension by 8 to 33 mm and their diastolic one by 4 to 20 mm of mercury. Some bio-chemical tests improved as well.

In small doses, garlic intensified the tonus of the intestinal muscles, thus increasing peristaltic movements, while in large doses, it inhibited them.

In experiments on animals and human workers exposed to chronic lead intoxication, garlic has been found to be an efficacious preventive and curative drug against saturnism.

In Cancer : Influence of garlic antibiotic on malignant tumours of humans as well as animals has been found to be useful. Transplanted tumours of Jensen sarcoma in rats regressed, and in some cases, completely disappeared after the injection of 1-3 mg of allicin, given either intramuscularly or directly into the tumour. However, all types of tumours do not respond equally well.

In Human Nutrition : There is an increase in the intestinal synthesis of vitamin B_1 on the administration of garlic to human subjects as alli-thiamine was formed by the reaction of thiamine (vit. B_1) and allicin, which was also absorbed faster than thiamine in the intestine. Thus, there appears to be a fundamental scientific basis for the therapeutic use of garlic and also

on the utilisation of food ingredients. It also provides a scientific explanation for its popularity as a folk medicine for over thousands of years in India, China and Egypt.

GINGER

Bot. Name : *Zingiber officinale Linn.*
Family : *Zingiberaceae*
Hindi: *Adrak*; Bengali: *Ada*; Gujarati: *Adu*; Kannada: *Shunti*, *Ardraka*; Malayalam: *Inji*; Marathi: *Ale*; Oriya: *Ada*; Punjabi: *Adrak*; Sanskrit: *Ardraka*; Tamil: *Inji*; Telugu: *Allam*; Urdu: *Adrak* or *Adhrak*.

Description and Distribution

Ginger of commerce or 'Adrak' is the dried underground stem or rhizome of the Zingiberous, herbaceous plant *Z. officinale*, which constitutes one of the 5 most important major spices of India, standing third or fourth, competing with chillies, depending upon fluctuations in world market prices and world demand and supply position. During the past three years, six to seven thousand tons of dried ginger of different grades, worth Rs 9-12 crores annually were exported to fifty countries. In fact, India still enjoys the unique position of being the largest producer and exporter of ginger in the world. India's production alone constitutes about 50% of the total world production of ginger. Besides, Indian ginger or Cochin ginger is also considered one of the best in the world.

Ginger, like cinnamon, clove and pepper, is one of the most important and oldest spices. It consists of the prepared and sundried rhizomes known in trade as 'hands' or 'races' which are either with the outer brownish cortical layers intact ('coated' or 'unscraped'), or with outer peel or coating partially or completely removed (i.e., 'uncoated' or 'scraped' or 'decorticated' ginger.) To improve their appearance, some

grades of ginger are bleached by various means, e.g. by liming, etc.

According to available historical records, ginger was certainly known to and highly esteemed by the ancient Greeks and Romans who obtained this spice from Arabian traders *via* the Red Sea. It was introduced into Germany and France in the ninth century and to England in the tenth century. Since the ginger rhizome can be easily transported in a living state for considerable distances, the plant has been introduced to many tropical and sub-tropical countries. It is now cultivated in several parts of the world, the most important producing regions being India, Jamaica, Sierra Leone and Nigeria (West Africa), southern China, Japan, Taiwan and Australia. Of these, Jamaica and India produce the best quality ginger, followed by the West African variety. Chinese ginger is usually not exported as a dried spice, but preserved in sugar syrup or converted into 'ginger candy'. It has low pungency and aroma and hence it cannot be used for distillation or extraction purposes. Japanese ginger possesses a certain pungency, but lacks the characteristic ginger aroma. Ginger produced in other countries (Malaysia, Indonesia etc.) is not of much commercial importance yet.

In India, about 70% of the total ginger production is confined to Kerala State alone which also produces the best quality ginger. The State-wise acreage and production of ginger is set out in Annexure II. In 1987-88, about 135,000 tons of ginger were produced, (Annexure IIA) out of which only 2000 tons were exported earning over Rs. 4.9 crores for the country. Ginger ranked fourth in value among all the spices exported from India during 1989-90, being next to pepper, chillies and turmeric (Annex-I).

The major bottlenecks in boosting up further exports of ginger are (i) its higher fibre content than that of its main competitor-Jamaican Ginger, in world markets, and (ii) its higher cost of production. Both these problems can be overcome by developing higher yielding, disease-resistant, exotic varieties of lower fibre content but richer in volatile oil and oleoresin content. Nearly 26 varieties of ginger are under study at Agricultural Research Station, Ambalavayal in Kerala, and elsewhere.

Ginger requires a warm and humid climate. It is cultivated from almost sea level to an altitude of 1500 metres, either under heavy rainfall conditions of 150-300 cm or under irrigation. The crop can thrive well in sandy or clayey loam or lateritic loam soils.

Composition

Dry Ginger-Moisture : 6.9%; protein : 8.6%; fat : 6.4%; fibre : 5.9%; carbohydrates : 66.5%; ash : 5.7%; calcium : 0.1%; phosphorus : 0.15%; iron : 0.011%; sodium : 0.03%; potassium : 1.4%; vitamins—vit. A : 175 I.U./100g; vit. B_1 : 0 05mg/100g; vit. B_2 : 0.13; niacin : 1.9; vit. C: 12.0 mg/100g; Calorific Value (food energy): 380 calories/100g.

It may be added that the composition of ginger varies with type or variety, region, agro-climatic conditions, methods of curing, drying, packaging and storage. Therefore, there are 7 different trade types of ginger, namely, (*i*) Jamaican ginger, (*ii*) Indian ginger, (*iii*) West African or Nigerian ginger, (*iv*) Sierra Leone ginger, (*v*) Japanese ginger, (*vi*) Rio de Janeiro ginger, and (*vii*) China ginger. The Indian ginger is further classified as (*i*) Malabar Ginger (Kerala) : (a) Cochin ginger (b) Calicut ginger or Wyanad ginger, (*ii*) Assamese ginger, (*iii*) Himachal Ginger. For export purposes, Cochin and Calicut gingers are graded according to the number of fingers contained in the rhizome. There are three export qualities, B, C, D, consisting of three fingers, two fingers, and pieces, respectively. Then there are 'bleached' or 'coated' ginger and 'uncoated', peeled or decorticated 'scraped' ginger and 'unscraped' ginger their prices depending upon their respective quality.

Chemical analysis of 26 varieties of ginger grown in India was conducted at CFTRI, Mysore, which showed the following range of variations in important qualities—moisture: 8.5-16.5%; (av. 10.85%); volatile oil: 1.0-2.7% (av. 1.8%); oleoresin (acetone extract): 3.9-9.3% (av. 6.5%); water extract: 14.4-25.8% (av. 19.6%); cold alcohol extract: 3.5-9.3% (av. 6.0%); starch: 40.4-59.0% (av. 53%); crude fibre: 4.8-9.80%) (av. 7.17%); crude protein: 10.3 to 15.0% (av. 12.4%); total ash: 5.1-9.3% (av. 6.64%) water soluble ash: 3.9-8.84% (av. 5.48%) acid insoluble ash : 0.0-0.59% (av. 0.14%) and alkalinity of

ash : 25.7-79.0 (av. 48.1) ml. of 0.1N HCl per 100g. of unpeeled ginger.

'Mysore', 'Manantody' and 'Ernad Manjari' varieties were found to be rich in volatile oil content. 'Assam' and 'Manantody' were rich in oleoresin (acetone extract). 'Thinladuim', 'Jorhat' and 'Assam' were fibrous. 'Nadia', 'Vengara' and 'Narasapatam' were highest in starch content.

The author and his associates developed an integrated process for the economic recovery of volatile oil from peel, oleoresin and starch from the spent residue. Varieties rich in volatile oil, oleoresin, and starch should make the venture more successful.

Volatile Oil : On steam distillation, dried, cracked and comminuted ginger yields 1.0 to 3.0% (av. 2.0%) of pale yellow, viscid oil. The oil possesses the aromatic odour but not the pungent flavour ('bite') of the spice. Of course, the odour of the oil is quite lasting.

The physico-chemical characteristics of the oil vary depending upon the variety, age or period of storage and method of extraction, etc. They range as follows—Sp. gravity at 15°C : 0.876-0.887; Optical Rotation: —30° to —44° 20', occasionally as low as —23° 58,'. Refractive Index at 20°C: 1,4876 to 1,4917; Acid number: 1.1-3.7; Sap. Number : 0.9-11.2 (upto 20.6).

It is more economical and convenient to recover oil or oleoresin from dried ginger than from fresh ginger. However, fresh scrapings of ginger are quite rich in oil and should be immediately used for steam distillation, otherwise, 60-80% of the volatile oil is lost overnight, as experienced by the author in his detailed studies on the development of useful products from ginger, including volatile oil, oleoresin and edible products from the exhausted or 'spent' ginger.

Ginger Oleoresin: is obtained by extraction of powdered dried ginger with suitable solvents like alcohol, acetone or any other efficient solvent. Unlike volatile oil, it contains both the volatile oil and the non-volatile pungent principles for which ginger is so highly esteemed. Concentration of the acetone extract under vacuum and on complete removal of even traces of the solvent used, yields the so-called oleoresin of ginger. The quantitative composition of the oleoresin

depends upon the solvent used. Ginger oleoresin (commercially known as 'Gingerin') generally contains the following compounds: gingerol, zingerone, shogaol, volatile oil, resins, phenols, etc. Ginger oleoresin is manufactured on a commercial scale in India and abroad and is in great demand by the various food industries.

Uses

(i) In Food Preparations: The aroma of ginger is pleasant and spicy and the flavour penetrating, slightly biting due to antiseptic or pungent compounds present in it, which make it indispensable in the manufacture of a number of food products like ginger bread, confectionery, ginger ale, curry powders, certain curried meats, table sauces, in pickling and in the manufacture of certain soft drinks like cordials, ginger cocktail, carbonated drinks, bitters, etc. Ginger is also used for the manufacture of ginger oil, oleoresin, essences, tinctures, etc.

(ii) Ginger candy/ preserve: Ginger preserve and ginger candy prepared from green or fresh ginger are quite a favourite of many and find great demand.

(iii) Recovery of starch and soft drinks from spent ginger: The author developed a number of useful products from spent or exhausted ginger (after the recovery of volatile oil) such as vitaminised effervescent ginger powder, vitaminised ginger powder, plain effervescent ginger powder. Likewise, the author suggested the recovery of starch from ginger residue left after the recovery of oleoresin. The integrated process for recovery of oleoresin, protein and starch recommended by the author is worth commercial exploitation.

(iv) Alcoholic Beverages: A number of alcoholic beverages are prepared from ginger in foreign countries, such as ginger brandy, ginger wine, ginger beer and ginger ales, etc.

(v) In Medicine: According to the Ayurvedic medical system, ginger is considered to be carminative, stimulant and given in dyspepsia and flatulent colic. It is also prescribed as an adjunct to many tonic and stimulating remedies. It also has aphrodisiac values, besides its use in tinctures and as a flavourant.

Use of Ginger Oil

(a) **As Flavourant:** Ginger oil is primarily used as a food flavourant in soft drinks like ginger ale, bitters, cordials and liquors, as a spice in bakery products, confectionery, pickles, sauces and preserves, etc.

(b) **Pharmaceutical Uses:** The pharmaceutical uses are carminative, rubefacient, stimulant, in alcoholic gastritis, dyspepsia, flatulent colic, etc. Veterinary uses of ginger are as stimulant and carminative, in indigestion of horses, and cattle, in spasmodic colic of horses, and to prevent the griping by purgatives.

(c) **Use in perfumery:** The oil of ginger finds limited use in perfumery, where it imparts a unique individual note to compositions of the oriental type.

HORSE-RADISH

Bot Name : *Cochlearia armoracia* Linn.
Family : *Crucifereae*

Description and Distribution

Horse-radish is a near relative of turnip, cabbage and mustard. It is one of the oldest condiments and is a well known large-leaved hardy perennial in many long established gardens. It is the thick white fleshy tasty root of horse-radish which is highly prized as an appetizing condiment with certain foods.

A native of the marshy districts of Eastern Europe, it is grown in the USA, to a small extent in gardens both in North India and the hill stations of South India. In the USA, about 7 million kg. of horse-radish are processed annually for consumption as food. Cultivated over 1500 acres, in the USA its varieties are classified into 2 types: 'Common' and 'Bohemian'. The common type has broad crinkled leaves and produces a

root of high quality. The Bohemian type has narrow smooth leaves, is more disease resistant but yields poorer quality roots. Horse-radish plant is highly sterile and hence is propagated asexually by root. The tap root is tuberous and cylindrical (i.e. 30 cm long and about 18mm in diameter), possesses an acrid, pungent taste and, when scraped or bruised, emits a characteristic pungent odour.

The root contains a pungent, acrid and vesicating volatile oil. The pungency is due to the presence of 'sinigrin', a sulphur containing glucoside, which in the presence of water and under the influence of an enzyme, yields 'allyl mustard oil' or allyl isothiocyanate as in mustard seed. Distillation of the tirturated root gives about 0.05 to 0.2% volatile oil which, according to the author's knowledge, is not produced on a commercial scale for obvious reasons.

Composition

Water: 73.4%; protein: 3.2%; fat: 0.2%; ash: 1.8%; total carbohydrates: 21.4% and fibre: 2.4%. The root is a rich source of vitamin C, the fresh material containing on an average, 302mg of ascorbic acid per 100g.

Adulteration: Prepared horse-radish is sometimes adulterated by admixture with turnips or parsnips followed by fortification with allyl isothiocyanate (synthetic mustard oil) to produce the desired pungency. It is rather difficult to detect this type of adulteration precisely. However, it may be stated, that horse-radish contains from 0.22 to 0.86% of natural allyl isothiocyanate on moisture free basis while parsnips and turnips contain practically none (less than 0.08%). Likewise, horse-radish also contains considerable starch content (av. 23%), while turnips contain less than 10% and parsnips from 11 to 18%. Besides, the infra-red spectrum of volatile oil of horse-radish, though practically identical with that of synthetic allyl isothiocyanate, differs distinctly from the spectrum of the volatile oil of parsnip. With the help of the above criteria, it may be possible to pinpoint the nature and extent of this type of adulteration.

Uses

(i) **As a Condiment**: Horse-radish is used as an appetising

condiment. It is credited with digestive and anti-scorbutic properties because of its high vitamin C content. It is highly prized as a condiment specially with oysters and meats. Besides, leaves and roots are used as food in Germany.

A freshly grated horse-radish root, when mixed with vinegar and salt, is much appreciated as an appetising and pungent condiment to enhance the flavour of boiled or roasted beef. When mixed with ketchup, the grated root imparts a refreshing taste to seafoods, especially shrimp, cocktail and oysters.

Horse-radish Cream, Sauce or Relish : Horse-radish is used for 'horse-radish cream' 'sauce' or 'relish' which is rather like salad cream and contains at least 25% shredded horse-radish (fresh) or equivalent dehydrated root and essential oil, 25% of a cream containing at least 25% edible vegetable oil and 7.5% of non-fat milk solids or NFMS (all percentages w/w). It includes egg yolk, milk, vinegar, salt and mustard.

(ii) In Medicine : Horse-radish is considered stimulant, diaphoretic, diuretic and digestive. It is also used as a counter-irritant in lumbago and similar painful affections. Crushed horse-radish has an inhibitory effect on the growth of micro-organisms, this effect being also attributed to allyl isothiocyanate.

HYSSOP

Bot. Name: *Hyssopus officinalis* Linn.
Family: *Labiatae*
Hindi: *Zufah-yabis;* Urdu: *Zufah.*

Description and Distribution

Hyssop is an aromatic, perennial shrub 30-60 cm high, found in the Himalayas from Kashmir to Kumaon at altitudes of 2435-3335 metres. It is native to Southern Europe and temperate zones of Asia. Branches are erect or diffuse; leaves sessile,

linear-oblong or lanceolate, obtuse, entire; flowers bluish purple, in auxiliary tufts arranged unilaterally on terminal branches; nutlets dark brown, narrow, trigonous, smooth. Leaves and flower tops constitute the condiment or spice.

The herb grows wild in countries bordering the Mediterranean. It is cultivated in Europe, particularly in Southern France, mainly for its essential oil; it is also grown in gardens for ornamental purpose. In India, it has been successfully cultivated at Baramulla (altitude 1675 metres) in Kashmir. The plant thrives in light rich soil in hill stations. It may be propagated by seeds, cuttings and divisions.

Composition

The herb contains volatile oil, fat, sugar, choline, tannins, carotene (108.1 mg/100g) and xanthophyll (355.6 mg/100). The tops contain ursolic acid (0.49%). A glucoside diosmin which on hydrolysis yields rhamnose, glucose and the aglucone diosmetin (4′-methyl luteolin), has also been isolated. Hyssop is stated to yield a greyish green dye. The fresh herb contains iodine in a concentration of 14 mcg/kg.

Volatile Oil: A volatile oil is obtained by the steam-distillation of the aerial parts of the plant. The yield of oil is 0.15-0.30% from fresh and 0.3-0.8% from dried materials; the maximum yield is obtained from plants harvested just after the blossoms open. The oil obtained from all overground parts of the plant is of uniform quality. Hyssop oil is colourless or greenish yellow with an agreeable aromatic, somewhat camphoraceous odour, and warm, slightly bitterish taste. It has the following range of constants—Sp. gr. at 15° : 0.935-0.952; Optical Rotation : 15.75° to 18.3°; Refr. Index at 20°C: 1.4783-1.4829; Sap. Val. : 2.8-12.1. It is soluble in 1 vol. of 80% alcohol, clear to cloudy with more; in exceptional cases, incompletely soluble in 80% alcohol. Its quality is more or less uniform, irrespective of the part from which the oil has been obtained, the properties varying slightly when the oil is distilled from herbs harvested during the flowering and withering periods.

Steam-distilled oil from the herb collected from Baramulla (yield 0.36% and 0.7% respectively from fresh and dried herb)

had the following constants—Sp. gr. 15° : 0.9375 and Refr. Index at 20°C : 1.4778. About 50% of hyssop oil consists of the ketone l-pinocamphone.

Adulteration: Because of its relatively high price, hyssop oil is occasionally adulterated with spike, lavendar, lavandir or rosemary oils.

Most dangerous are additions of camphor oil fractions, because they are not easily detected in routine analysis. In fact, the presence of camphor may denote a high content of pinocamphone, the latter in pure oils being indicative of a good quality. Obviously the addition of d-camphor would affect the laevorotation of pure hyssop oil which helps in detection of adulteration.

Uses

(i) As Condiment: The leaves and flowering tops of hyssop have an agreeable aromatic odour and a warm, pungent, bitterish taste. They are employed as flavouring for salads and soups, and also in the preparation of liquor and perfumes. Occasionally, the green parts are used as pot-herb.

(ii) In Medicine : Hyssop is considered stimulant, carminative and pectoral, and used in colds, coughs, consumption and lung complaints. An infusion or tea prepared from the plant is said to be effective in nervous disorders and tooth-ache and in pulmonary, digestive, uterine and urinary troubles. Leaves are stimulating, stomachic, carminative, useful in hysteria and colic. The leaf juice is employed for the expulsion of round worms. The crushed herb is applied as a resolvent and vulnerary.

Infusion of plant is reported to be useful in asthma and coughs. Steeped in hot water, it is used as a resolvent and vulnerary, as fomentation for wounds, sprains and strains, muscular rheumatism and for clearing discoloration of skin due to blows. It is also used as a salve in catarrhal opthalmia.

Hyssop was at one time official in some pharmacopoeias of Europe. '*Zufah yabis*,' a drug sold in Indian bazaars and imported from Syria and Iran, has medicinal properties almost similar to those of hyssop. It has been referred to as *H. officinalis* by some authors, but this identity is doubtful.

(iii) Use of Volatile Oil : Hyssop oil is used as a flavouring agent in bitters and tonics, especially in French liqueurs of the Chartreuse and Benedictine type. It is also used to some extent in perfumes with a spicy odour.

In small dose (1 or 2 drops) the oil promotes expectoration in bronchial catarrh and asthma. It produces mild clonic convulsions when injected intravenously. In dogs, intravenous injection of 1-2 ml/kg of a saturated solution of essential oil in 33% ethyl alcohol causes a small increase in blood pressure and respiration, then mild clonic convulsions, then a decrease in blood pressure and increase in heart rhythm.

JUNIPER

Bot. Name : *Juniperous communis* Linn.
Family : *Pinaceae*
Hindi : *Aaraar, Haubera, Abhal;* Bengali : *Havasha;* Kashmiri : *Betar, Petthra, Pama, Chui, Haulber;* Kumaon : *Chichia, Jhora;* Deccan : *Abhal;* Punjabi : *Betar, Petthri, Chui;* Sanskrit : *Vapusha;* Urdu : *Abhal, Saru.*

Description and Distribution

Juniper which is found in the Himalayas from Kumaon westwards at altitudes of 1520 to 4270 metres is an evergreen shrub, sometimes attaining the height of a small tree with erect trunk and spreading branches, covered with a shreddy bark. The leaves are straight and rigid, oval shaped, about 6 to 13 mm long, with sharp prickly points. The male and female flowers produced in April and May are usually borne on separate plants, the male flowers in short catkins and female flowers in short cones. The fleshy berry like fruit does not ripen until the second year. The roundish fruit is sub-globose, bluish black dark-purple when ripe 10 to 13 mm in diameter, covered with a waxy blook; the three scales comprising the fruit occasionally

gaping and exposing seeds; bony seeds usually 3, elongated, ovoid, embedded in a brownish pulp. The plant is very variable with a number of geographical varieties and garden forms; it becomes prostrate, not more than 60-90 cm in height at higher attitudes in the Himalayas. The plant flowers in March-April and fruits ripen in August-September of the second year. Under natural conditions, the seeds are freely spread by by birds, which devour the fruits. Juniper fruits have a gin like aroma and a sweet terebinthinate taste with a somewhat bitter after-taste. The juniper berries of commerce are obtained by drying the ripe fruits. Oil of juniper is obtained by steam distillation of these berries and is in great demand.

Composition

The fruits contain, besides the volatile oil, fermentable sugars (33%), resin (8%), juniperin, probably a mixture of tannin and sugars (0.36%), fixed oil, protein, wax, gum, pectins, organic acids (formic, acetic, malic, oxalic, and glycolic), and potassium salts. They are a good source of ascorbic acid (about 35mg/100g).

Adulteration: Formerly, juniper berries were frequently found adulterated with berries of inferior varieties/species namely, (1) *J. communis* var '*Nana*' Loud, (2) *J. Oxyeedrus* Linn, but due to (1) present high cost of collection of berries from these wild species/varieties from higher altitudes, (2) stricter enforcement of quality standards, they are no longer admixed with true juniper berries.

Volatile Oil: Juniper oil is obtained by steam-distillation of ripe fruits, the yield varying from 0.8% to 1.6%, according to the quality of fruits distilled. The oil from green unripe fruits is inferior; in over-ripe fruits, the oil changes into a resin. The bulk of the commercial oil is obtained as a by-product, during the distillation of alcoholic beverages. The oil, however, is partly deprived of the natural oxygenated odoriferous compounds.

Composition of Volatile Oil: Juniper oil is a colourless or pale greenish yellow limpid liquid with a characteristic odour of the fruit and a somewhat burning bitter flavour. On storing, the oil turns viscous and acquires a turpentinic odour.

The characteristics of fresh oil obtained by the steam-distillation of the ripe fruits usually vary within the following limits— Sp. gr. 15°: 0.867-0.882; Refractive Index at 20°C: 1.472-1.484; Optical Rotation upto—13° (occasionally dextro-rotatory); acid val.: upto 3; ester val.: 1-12; and ester val. after acetylation: 19-31: solubility in 90% alcohol: 1 in 5-10 vol. becoming less soluble with age.

The fruits obtained from Hoshiarpur (Punjab) market gave an oil (yield 0.83%) with the following constants—Sp. gr. at 27°C: 0.918; Refr. Index at 25°C: 1.482; Optical Rotation: +20.8°; acid val.: 4.7; and ester val. : 20.5. The I.P.C. requirements for the oil are as follows—Sp. gr. at 20°: 0.862-0.892; 20°D: 1.476-1.484; and Optical Rotation: 1 to −15°

The oil contains d-α-pinene as the major constituent together with smaller amounts of camphene, cadinene, juniper camphor (possibly a sesquiterpene alcohol), a hydrocarbon (junene) with strong diuretic properties, terpinenol, certain unidentified oxygenated compounds possessing the characteristic juniper odour, and traces of esters.

Uses

(i) As Food and Food Flavourant: They are employed for flavouring gin and food products; they are sometimes used as an article of food. Large quantities of the fruit are used in Europe for the preparation of alcoholic beverages of the gin type. For this purpose, the fruits are crushed, immersed in warm water and fermented; the fermented mass is then distilled and rectified; 1,000 kg of fruit yields 16-18 litres of beverage (containing 40-50% alcohol) and 5-6 kg of volatile oil.

Juniper oil is largely used in compounded gin flavours, liquor and cordials. A twice rectified oil has high flavour value. Imitation juniper oils have been produced.

All parts of the the tree contain volatile oil. A terebinthinate juice exudes from the tree and hardens on the bark; it has been erroneously considered to be identical with gum Sandarac (from *Tetraclinis articulata*).

Terminal twigs and needles yield (0.15-0.18%) a bright yellow oil (Sp. gr. 20°: 0.8531) with the characteristic odour of juniper oil; it contains d-α-pinene, camphene and cadinene.

(ii) **In Medicine:** The fruits and the volatile oil possess carminative, stimulant and diuretic properties and are useful in different forms of dropsies, especially in conjunction with other drugs. They have been used in disorders of the urino-genital tract, such as gonorrhoea, gleet and leucorrhoea, and in certain cutaneous diseases. Dried fruits are sold in the bazaars of North India and are reported to be imported from Nepal *via* Panta and are used in the treatment of gonorrhoea.

The oil of juniper berries has been known for a long time as a diuretic. Because of its local irritating effect on inflamed organs, however, great care must be exercised in its dosage.

The wood is diuretic, sudorific and blood purifier; it is employed in gout, rheumatism and cutaneous diseases.

Other Uses/By-products: The exhausted fruits (left after the distillation of oil) on repeated extraction with warm water and concentration, yield (30-38%) a product known as 'Succus Juniperi.' The preparation, consisting chiefly of invert sugar, was formerly used in Europe as a diuretic and sudorific. Exhausted fruits are used as feed for stock. They contain, moisture: 23.72%; crude protein: 6.23%; ether extr: 10.75%; crude fibre: 27.16%; N-free extr. 38.0%; and ash: 4.14%. The ash is rich in calcium and potassium. Feeding trials on sheep gave the following digestibility co-efficients—N-free extr.: 66%; protein: 39%; ether extr. 37%; and crude fibre: 20%.

Juniper needles are rich in ascorbic acid (88 mg/100g); they also contain resin, wax and esters.

The fruits and roots yield brown and purple dyes respectively. The bark is said to be used in Russia for tanning.

The wood of juniper (wt. 33lb/cft) is brownish, moderately hard, durable, fragrant, highly resinous and easy to season. It is usually available in small sizes and used for fencing, veneering, turnery and as fuel. The wood and young twigs are burnt as incense.

Juniper Wood Oil is obtained by the steam-distillation of wood; it has the following constants—Density at 15°: 0.8692; Optical Rotation: 21.03°; Refractive Index at 20°C: 1.4711; acid val.: 0.9; ester val.: 6.7; solubility in 90% alcohol: 1 in 7 vol. or more, with slight turbidity. It contains cadinene and a sesquiterpene. Commercial juniper wood oil is usually obtained

by distilling turpentine with juniper woods and twigs; more often, it is a mixture of turpentine and juniper oil. The bark oil obtained by the steam-distillation of bark (yield 0.25-0.50%) contains juniperene, juniperol α-pinene and silvestrene.

KOKAM

Bot. Name: *Garcinia indica* Choisy.
Family: *Guttiferae.*
Hindi, Bengali and Punjabi: *Kokam;* Gujarati: *Kokan;* Kannada: *Murgala;* Malayalam: *Punampulli;* Marathi: *Amsol*, *Katambi*, *Kokam*, *Ratamba;* Tamil: *Murgal.*

Description and Distribution

Kokam, also known as 'Kokam butter tree,' 'Brindonia tallow tree' or 'Mangosteen oil tree' should not be confused with 'Mangosteen' (*Garcinia mangostana*), another species of the same genus 'Garcinia.' Kokam is a slender evergreen tree with drooping branches; leaves ovate or oblong lanceolate, 6.25-8.75cm long and 2.5-3.75cm broad, dark green above and pale beneath; fruits globose or spherical 2.5-3.75 diam., dark purple when ripe, enclosing 5-8 large seeds. The tree is found in the tropical rain forests of the Western Ghats, from Konkan southwards in Mysore, Coorg and Wynaad It is often planted in the southern districts of Maharashtra. It is reported to flourish well on the lower slopes of the Nilgiri hills. It flowers in November-February and fruits ripen in April-May.

Composition

No published information available.

Uses

As Food/Flavourant: The fruit has an agreeable flavour and a sweetish acid taste. It is used in Konkan area chiefly in the form of Kokam prepared by drying the outer rind, soaking it

repeatedly in the juice of the pulp and sun-drying. Kokam contains about 10% malic acid and a little tartaric or citric acid. It is used as a garnish to give an acid flavour to curries and also for preparing cooling syrups during hot months. Kokam is reported to be imported into Zanzibar from India.

In Medicine: The fruit is anthelmintic and cardiotonic, and useful in piles, dysentery, tumors, pains and heart complaints. A syrup from the fruit juice is given in bilious affections. The root is astringent. The seeds of the fruit yield (23-26%) on the weight of seeds and about 44% on the weight of kernels, a valuable edible fat known in commerce as Kokam Butter. It is extracted mostly on a cottage industry basis by crushing the kernels boiling the pulp in water and skimming off the fat from the top; or by churning the crushed pulp with water.

Kokam butter is considered nutritive, demulcent, astringent and emollient. It is suitable for ointments, suppositories and other pharmaceutical purposes. It is used as a local application to ulcerations and fissures of lips, hand, etc. The cake left after the extraction of oils is used as manure.

The characteristics of the fat are as follows—Refr. Index at 40°C, 1.4565-1.4575; sap. val.: 187-191.7; iod. val. 25-36; unsapon. matter, 2.3%; R. M. val., 0.1-1.0; and m.p., 40-43°.

Kokam butter as sold in bazaars consists of egg-shaped lumps or cakes of light grey or yellowish colour with a greasy feel and a bland oily taste It is used mainly as an edible fat; it is used also as an adulterant of ghee. As ordinarily met with, it contains seed particles as impurities. Refined and deodorised fat is white in colour and compares favourably with high class hydrogenated fats.

This butter, like other Garcinia fats, is rich in combined stearic and oleic acids. It contains about 75% of mono-oleodisaturated glycerides. It is suitable for use as confectionery butter. However, as it solidifies with a rough surface, addition of another fat is necessary to correct the defect. It is also suitable for candle and soap manufacture.

A method has been developed for the production of stearic acid from the fat in a yield of 45.7%. It possesses properties similar to piney tallow (from *Vateria indica*) and may be employed in the sizing of cotton yarn.

STONE LEEK OR WELSH ONION

Bot. Name: *Allium fistulosum* Linn.
Family: *Liliacae*
Hindi: *Vilayaiti Lasson;* Marathi: *Khorat*; Malayalam: *Vellulli*; Oriya: *Bilati Rasuna.*

Description and Distribution

Distinction must be made between stone leek and winter leek, both being members of the onion and garlic family *Liliacae.* The former is *A. fistulosum* Welsh onion or 'Ceboule' or 'Japanese bunching onion,' while the latter is *A. porrum* 'winter-leek' or 'Leek'. It is reported that sometimes Welsh onion is used as a substitute for leek. The white stemmed stone leek is a native of eastern Asia and was domesticated in China and Japan. *A. fistulosum* has been mentioned in Japanese literature as early as 918 A.D., though of course under various names. Today, this bunching onion or Welsh onion is cultivated in Siberia, China and Japan. More recently, it has been introduced into Europe and then to Russia in 1956. In Europe, the USA and India it is grown mostly in home gardens In Japan, during 1955 and 1960, the average acreage under bunching onion was 58,500 acres which yielded about 342,000 tonnes or 5.8 tons per acre. In Taiwan, in 1958, production was 27,243 tons from 3271 hectares. Similar statistics are not available in most of the other producing countries.

Stone leek grown from cold regions of Siberia to the tropics of southern China and southern Asia shows its remarkable flexible range of adaption to climate. It does not produce bulbs and there is considerable difference in morphological characteristics of different cultivars.

Stone leek or Welsh onion is a hardy perennial but it is grown as an annual or biennial. It does not form a real bulb but only a small enlargement at the base. It may be propagated by division or seeds; the latter is preferred. It is not grown on a commercial scale in India but only as a kitchen garden plant.

Composition

Composition of stone leek is almost similar to that of leek (*A. porrum*) which is as follows—moisture: 78.9%; proteins: 1.8%; fat: 0.1%; minerals: 0.7%; carbohydrates: 17.2%; calcium: 0.05%; phosphorus: 0.07%; iron: 2.3mg; vit. A:30 I.U.; vit. B_1: 0.23 mg and vit. C: 11mg/100g; Calorific Value: 77 calories/100g. It is also comparatively rich in combined sulphur (0.06-0.072%).

Uses

Like the other green bulb onion, stone leeks are used for flavouring or for livening the dull starchy diets of eastern peoples. They are also used in salads or eaten raw alone or used as a flavouring in soups and stews. They are mild flavoured. The tender leafed varieties are raised for their edible tops while the others for their white blanched leaf-bases.

Little information is available on their technological utilization, volatile oil, sulphur compounds and their antiseptic properties, etc. as is so well known about onion and garlic, the elder brothers in the family.

LOVAGE

Bot. Name: *Levisticum officinale* Koth.
Family: *Umbelliferae*

Description and Distribution

Lovage is a perennial plant of the parsley family (*Umbelliferae*), introduced from Europe. It has been grown occasionally as a garden plant. It is not cultivated in certain localities in New England, the USA and some European countries. Lovage grows well in almost any soil, especially well-drained soil where maize or potatoes can be produced satisfactorily. It is propagated by seed or root division. The roots are dug out in

October of the second or third year after setting the plants. The freshly dug out roots are washed, cut into slices about 13mm thick and carefully dried. Artificial drying at 52°C may be used to hasten drying. A yield of 450 kg. of dried root per acre is reported.

Composition

No published information available.

Uses

The root has long been supposed to have medicinal properties and is in some demand in the drug trade. The roots, seeds and leaves are used for flavouring foods. The seeds are used for flavouring confectionery. Flavouring tops yield a volatile oil. The leaf stems are sometimes blanched like celery and eaten as a salad. The comminuted dry roots, on steam distillation, yield volatile oil, known in the trade as lovage oil which is reported to contain some interesting 'artefacts'.

MACE

Bot. Names: *Myristica fragrans* Hout.
Family: *Myristicaceae*
Hindi, Bengali, Gujarati and Marathi: *Jaivitri*, *Japatri*, *Jotri*, *Jaiphal*, *Payapatri;* Kannada: *Japatre;* Kashmiri: *Jaabvatur;* Malayalam: *Jathipathri*; Oriya: *Jaitre;* Punjabi: *Jaiphal*, *Jaivatri*, *Jaipatri;* Sanskrit: *Jatiphala;* Tamil: *Jadhipattiri;* Telugu: *Japatri.*

Description and Distribution

Mace and nutmeg are two distinctly different spices produced from a single fruit of an evergreen, aromatic nutmeg tree usually 9-12 metres high, but sometimes reaching a height of 20 metres or more. Mace is the dried reticulated aril of nutmeg. When the peach or apricot-like nutmeg fruit bursts open, the mace is seen as an attractive bright scarlet cage closely

enveloping or clothing the hard, thin, black shining shell of the seed called nutmeg. The mace is skilfully removed, gently pressed flat, dried, and is called the typical 'blade of mace.' On drying, the original scarlet colour of the mace turns rather pale yellowish brown or reddish brown and becomes brittle.

The flavour of mace is similar to that of nutmeg but is more refined. Mace is much more expensive than nutmeg. Poor mace has usually little aroma and is brittle. Both the spices are used for flavouring a number of foods and beverages and also used in medicine. Their pleasant aroma is due to the essential oils present in them which again are similar in organoleptic and physico chemical properties.

M. fragrans is a native of Moluccas, now cultivated in many tropical countries of both hemispheres (Malaysia, Indonesia, West Indies, India, Sri Lanka, etc.). In India, it is grown in Tamil Nadu (Nilgiris, Burliar, Coimbatore, Salem, Ramanathapuram, Tirunelveli, Kanyakumari and Madurai districts); Kerala, Assam and other States. Preliminary trials have shown that Araku valley (Andhra Pradesh) and Wynad (Kerala) are well suited for its cultivation.

M. fragrans requires a hot and moist climate with a rainfall of 150-300 cm per annum. It grows best at low elevations in alluvium formed of deep friable loam with good drainage, well sheltered from high winds; it does not thrive above an altitude of 750 metres.

Commercial mace consists of flattened lobed pieces, 2.5 cm or more in length, somewhat less in breadth and 1 mm thick. When soaked in water, the lobes swell up and regain their original form. It is dull yellowish red in colour, translucent and brittle. In odour and taste, it resembles nutmeg, but is softer and more delicate. Three types of mace are recognised as follows:

(*1*) *Banda mace*, considered to be the finest. It has a bright orange colour and fine aroma.

(*2*) *Java Estate mace* is golden yellow, interspersed with brilliant crimson streaks like Banda mace; it is free from insect infestation.

(*3*) *Siauw mace* is of lighter colour than Banda mace and contains less volatile oil.

(4) *Papua mace*, often regarded as the fourth grade of *East Indian mace*, is derived from *N. gentiea.* It contains comparatively little volatile oil and that too of an undesirable turpentine-like aroma. It is entirely unsuitable for distillation purposes. West Indian mace is comparatively inferior in quality.

Banda and Penang mace are considered by the trade all the world over as of superior quality. This 'true' mace must be differentiated from mace consisting of the aril of *Myristica argentica* Warsh known as *Macassar or Papua Mace* or of aril of *Myristica malabarica* Linn known as 'Bombay Mace' or 'Wild mace'. The first tree is native to New Guinea and the second to India.

Being a thin lacy material, the mace is very light in weight and consequently, for every 100 kg. of nutmeg a tree produces, it yields only 3-3½ kg. of mace. Its quality depends upon its essential oil content.

Mace is available in the market as 'whole', 'broken' or 'ground'. Mace is in great demand in India. During 1971-72, about 7,840 kg of mace valued at over Rs. 1 lakh was imported into India, mostly from eastern Asian countries. Area under nutmeg/mace is being gradually extended in Kerala, Tamil Nadu and elsewhere.

Composition

Moisture: 15.9%; protein: 6.5%; ether extraction: 24.4%; carbohydrates: 47.8%; fibre: 0.8%; mineral matter: 1.6%; calcium: 0.18%; phosphorus: 0.13%; iron: 12.6 mg/100g. It contains a volatile oil (4-15%), amylodextrin (25%), reducing sugar, pectin, resins and colouring matter, etc. It also has vit. B_1: 0.37, vit. B_2: 0.56; niacin: 1.2; vit. C: 12mg/100g and vit. A: 175 IU/100g. The chief constituents are the volatile oil (oil of mace) to which the flavour is mainly due, and amylodextrin. The leaves of *M. fragrans* yield on water distillation, 0.41 to 0.60% of a light brown volatile oil (specific gravity at 30°C 0.864 and ester val. 144) with a pleasing spicy odour. Steam distillation of dried leaves (from East Indies) gave 1.58% of a colourless volatile oil containing α-pinene (80%) and myristicin (10%).

Oil of Mace resembles nutmeg oil in odour, flavour and

composition and no distinction is made between them in the trade. However, the comparative quality attributes of oil of mace of East Indian and West Indian orgin are given below:

Comparative Physico-Chemical Properties of *Oil of Mace*

Properties	*East Indian Oil*	*West Indian Oil*
Yield of oil%	10.4 to 16.4	8.5 to 15.0
Sp. Gravity at 20°/20	0.923 to 0.947	0.860 to 0.892
Optical Rotation at 20°	+2°42′ to +11°48′	+21°18′ to +41°30′
Refractive Index at 20°	1.486 to 1.494	1.492 to 1.479
Acid Number	2.0 to 3.9	1.5 to 6.2
Ester Number	1.2 to 9.3	2.8 to 12.8

Like nutmeg oil, mace oil also becomes viscous on storage due to absorption of oxygen. Old mace yields more viscous oil than the fresh one. Hence the importance of judging the freshness of mace.

Fixed Mace Oil : Mace yields a fat similar to that from nutmeg but in a much smaller amount. A sample of Indian mace gave 26% of a red coloured fat (18-20% after removal of volatile oil) an extraction with carbon tetrachloride. It has the following characteristics—Specific Gravity: 0.9884; Refractive Index: 1.4850; Acid Val: 3.4; Sap. val.: 108; Iodine value: 153-57: R.M. val. 7.2; Polenske val.: 0.72; Acetal val.: 65-67; and Unsapn. Matter: 35%. The characteristics of refined oil, after removal of volatile and resinous matter, were as follows—Sp. Gravity: 0.9769; Refractive Index: 1.4835; Sap. Val.: 161-62; and Iodine Val.: 118-19. The fixed oil is a semi-drying oil. However, it may not be economical.

The amylodextrin is present in mace in the form of granules, visible under the microscope (size 5.7μ). They are compound and irregular in shape with a distinct hilum.

Adulteration : Pure mace, whole or broken, is sometimes adulterated with wild mace (*M. malabaricum*) of inferior quality. In the case of ground mace, the common adulterants are farinaceous products and ground wild or cheaper mace.

Uses

Nutmeg and mace are generally classified as baking spices, since both are particularly good in sweet foods (doughnuts and sweet doughs, especially). However, they find a much wider range of use than other baking spices. They are frequently included in frankfurter formulae and in recipes for curried meat and other products. They are much used in soups and preserves, in sauces, in combinations with dairy products (eggnog being perhaps, the most famous for nutmeg). Nutmeg, in general, tends to be sweeter and more delicate than mace. For light coloured foods, such as pound cakes, cream pies and cream soups, mace is often chosen because of its own light orange colour.

In India, mace and nutmeg are used more as drugs than a condiment due to their valuable medicinal properties. Both are stimulant, carminative, astringent and aphrodisiac and are used in pharmaceutical preparations for dysentery, stomach ache, flatulence, nausea, vomiting, malaria, rheumatism, sciatica and leprosy (early stage). Excessive doses, however, have a narcotic effect. Mace, which has got similar uses, is also chewed for masking foul breath. However, use of nutmeg is greater in the kitchen and in medicine than mace. Their volatile oil is used as a flavourant in liquor, tobacco, and dental creams, etc.

MARJORAM

Bot. Name: *Majorana hortensis* Moench.
Family: *Labiatae*
Hindi: *Marwa;* Bengali: *Murru;* Deccan: *Muruva*; Kannada: *Maruga*; Kumaon· *Bantulsi*; Malayalam: *Maruvamu*; Punjabi: *Marwa*; Sanskrit: *Maru*; Sindhi: *Murwo*; Tamil: *Maruvu, Maru*; Urdu: *Marva khusha.*

Description and Distribution

It is the dried leaves of marjoram or sweet marjoram with or without flowering tops in small proportion that constitute the spice of commerce. It is an aromatic herb, of the mint family, 30-60 cm high. It is extensively cultivated in India. Sweet marjoram is characterised by a strong spicy and pleasant odour. The flavour is fragrant, spicy, slightly sharp, bitterish and camphoraceous. Though a perennial, it is treated as an annual under cultivation. A native of southern Europe, it grows in western Asia, South and North America, France, Germany, Hungary, Spain, Portugal, England and North Africa. The colour of the dried herb is light green with a slight greyish tint. The whole leaves are small with hairs on both sides of the leaf. When examined under the microscope (low power), many dotsized oil glands are seen on the leaf. They yield 3.5% volatile oil.

Composition

Analysis of the dry herb gave the following values—water: 7%; protein: 14.31%; fixed oil: 5.60%; volatile oil: 1.72%; pentosans: 7.68%; fibre: 22.06%; ash: 9.69%; tannin-an astringent substance, and ursolic acid (0.21% in tops; 0.05% in stem) are present.

There is wide variation in the mineral content of Indian, French and German sweet marjoram herb; total ash: 6.3 to 24%; sand 0.66-14%; sand-free ash; 5.4-14.3%; potash: 18.3-20.2%; sodium: 0.65-0.68%; calcium: 17.6-24.8%; phosphorus: 8.9-9.1%; iron: 6.1-7.3%; silica: 19.4-26.5%; magnesium: 4.8-6.7%; manganese: trace to 1.05%; and chlorine: 1.51-2.05%. Commercial sample of marjoram should contain crude fibre: 22% (max.); total ash: 13% (max.); acid insoluble ash: 3.5% (max.); volatile oil: 1.0% (min); moisture 10% (max.); and total ether extract: 6.5 (min). Sweet marjoram contains about about 14.5% protein, 5.6% fixed oil and 7.68% pentosans.

Volatile Oil : Steam-distillation of the leaves and flowering heads yields volatile oil, known in the trade as 'Oil of Sweet Marjoram' (yield from fresh flowering herb, 0.3-0.4%; dry herb: 0.7-3.5%). The oil is colourless or pale yellow to yellow-green, with a tenacious odour reminiscent of nutmeg and mint.

A sample of Indian oil (from Delhi) had the following physico-chemical properties—Density at 15°: 0.9346; Refractive Index: 1.5062; Optical Rotation: +40.25°; Acid Val.: 4.8; Sap. Val.: 8.32; Sap. Val. (after acetylation): 128.4; and phenol content: 47.7%. The oil consisted of carvacrol (36.4%), eugenol (6.7%), chavicol (4.6)%, d-linalool (30.6%), methylchavicol (3.2%), d-α-terpineol 4.8%), and caryophyllene (7.6%).

Oils of European origin differ considerably from the Indian oil and have usually the following ranges of characteristics—Density at 15°C: 0.894-0.901; Refractive Index: 1.470-1.476; Optical Rotation: +15° to + 25°; acid val.: upto 1.5; ester val.: 10.0-38.0; ester val. (after acetylation): 41.0-78.0; sol. in 1-2 vols. and more of 80% alcohol. They contain about 40% terpenes (mainly terpinene) but are free from phenols: d-α-terpineol and terpinenol are also present. Sweet marjoram oil is often confused in commerce with thyme oil (from Thymus spp.) and origanum oil (from Origanum spp.)

Uses

As Food Flavourant : Marjoram leaves are used by the industrial manufacturers for flavouring liver and polish sausages and cheese, in soups, stews, dressings, salads, egg and vegetable dishes, cheese, fancy meat sausages and poultry dressing.

The leaves of the plant are used fresh or dried and highly esteemed as a condiment for seasoning food; they are used also as a poultry-seasoner. Fresh leaves are employed as garnish and incorporated in salads; they are used also for flavouring vinegar. Dried flowering tops are used for sachets and potpouri. The aromatic seeds are used in confectionery and French confitures.

In Perfumery and Cosmetics : The oil is employed to a small extent in high grade flavour preparations and perfumes and in soap and liquor industries.

In Medicines : Sweet marjoram is considered carminative, expectorant and tonic; leaves and seeds are astringent. An infusion of the plant is used as stimulant, surorific, emmenagogue and galactagogue; it is reported to be useful in asthma, hysteria and paralysis.

Sweet marjoram oil is used as an external application for

sprains, bruises, stiff and paralytic limbs and tooth-ache, and for hot fomentation in acute diarrhoea. Intravenous injection of 1 cc per kg body weight of dogs of a saturated solution of essential oil in 33% ethyl alcohol increased peristaltic movements of intestine. Leaves and seeds are reported to provide a remedy for colic.

MINT OR JAPANESE MINT

Bot. Name: *Mentha arvensis* Linn.
Family: *Labiatae*
Hindi, Bengali, Gujarati, Marathi, Punjabi and Urdu: *Pudina*; Kashmiri: *Pudyanu*; Malayalam: *Muthina*; Tamil & Telugu: *Pudina.*

Description and Distribution

Mint or 'Pudina' is known to one and all, as used in 'chutney' and as an old popular household remedy for relieving cold and cough. It belongs to the genus Mentha which consists of about 40 species of aromatic perennial herbs distributed mostly in the northern hemisphere (Europe, America, Japan, China, Brazil and Formosa). In India, about 8 species of Mentha are reported to occur or grow. However, the world demand for peppermint oil and menthol is met from the following 3 species which have also been approved/recognised by the ISO (International Organization for Standardization) for the purpose of quality standards and international marketing:

(1) *Mentha arvensis* Linn var. *Piperascens malinvaud.*
(2) *Mentha piperita* Linn var. *piperita.*
(3) *Mentha spicata* Linn.
Syn: *Mentha virides* Linn.

For our purpose, therefore, we shall confine our discussion to these 3 species only and in the alphabetical order. These species yield peppermint oil which finds several industrial

uses mainly because of its menthol content. The mentha species growing naturally in India have been observed to yield peppermint oil of desirable quality but still its demand is evergrowing and its imports have been ranging between Rs. 86 and 102 lakhs annually. The country's annual requirement of peppermint oil is about 10 tons which can be met by growing the crop over 10,000 acres. In addition, menthol worth Rs 1.5 to 2 lakhs is also being imported annually from the UK, the USA, Japan and China despite the fact that the cultivation of *M. piperita* in India was taken up as early as in 1881 (!). The different species were raised in Nilgiris and Mysore and the indigenous Mentha in Kashmir, but the oil then obtained was not of the B.P. standard. In 1952, rooted suckers of Japanese mint (*M. arvensis* var *piperascens*) obtained from Japan and planted in Jammu and Srinagar, gave promising results with regard to their growth and yield of oil. Now, Japanese mint is cultivated on a large scale in Jammu and and Kashmir (over 2000 acres) and in Tarai and Haldwani areas in UP, covering more than 3000 acres. The other centres of production are Chakrohi (J & K), Kuppam (AP) and Jullundur (Punjab). Japanese mint is a downy perennial herb with running rootstocks and rigid branching stem, 60-90 cm high, cultivated at an altitude of 270-1500 m. This species is more robust than *M. arvensis*. It does not breed true from seed. Due to its wide adaptability, it can be cultivated all over India. Temperate to tropical climates suit it well. Sunny weather with moderate rainfall is conducive to its luxuriant growth and high menthol content.

In *arvensis*, the introduced strain Japanese mint is now well adapted under different agro-climatic conditions of the country. Jammu mint, which is a tetraploid of Japanese mint, gives as high as 5% oil (dry wt.) as compared to an average of 2.5-3% (0.5 to 0.8% on fresh weight basis) in the normal diploid. The world's demand for Japanese mint oil or Japanese peppermint oil, as commonly known, and natural menthol is met mainly from Japan and to a lesser extent from China and Brazil.

The mint crop gives maximum oil content when it has just reached the flowering stage, after which the oil content begins to decline, but in cases where there is delayed flowering, as at

Delhi, yellowing of the lower leaves is an indication for cutting in time. 2-3 cuttings are done during the season. Freshly cut herb is left in the field for 2-4 hours during the sunny weather. This partially dried herb is further dried in small bundles by hanging over wires in shade till it is reduced to 1/3 or 1/4 of its original weight, taking care that the leaves do not get crisp. The crop should not be heaped for drying in the sun as it is reported to result in reduction of oil by about 20-25%.

Volatile Oil & Menthol: Distillation of dried leaves is cheaper than that of fresh leaves. By steam distillation and filteration, a golden yellow volatile oil is obtained. Leaves and flowering tops give the highest yield. About 50% of menthol can be separated out in crystalline form on cooling the oil. The remaining (dementholised) oil is used as peppermint oil. Manufacture of menthol from dementholised oil has been taken up on commercial scale by three or four firms in Bombay, West Bengal and Gujarat. There are several small distilleries in UP for the distillation of oil.

The peppermint oil is stored in coloured bottles, air-tight aluminium or galvanised containers in cool dry place. Presence of moisture in the oil may rancidify the oil. Since it is acidic in nature, it should not be stored in tin containers.

Composition of Oil : The natural oil yields on an average 40-50% menthol and 50-60% dementholised oil which can be used both in confectionery and medicine in place of imported peppermint oil. Japanese mint oil is not distinguished from the peppermint oil in the Indian trade. The dementholised oil has been found to contain menthyl acetate (24.4%), free menthol (44.8%), menthone (24.6%) and hydrocarbons (6.2%). Among the hydrocarbons, alpha-pinene, α-l-limonene, carophyllene and cademene are present.

The quality of Japanese mint oil grown in Jammu and UP compares favourably with that of those obtained in Japan and Brazil. Its physico-chemical properties are—Specific Gravity at 25°C: .8969-9903; Refractive Index at 25°C: 1.4494 to 1.4573: Optical Rotation: 41°2'; congealing point: 15.0; acid value: 1.5-2.8; ester value: 14.12 to 29.47%; Total Menthol: 81.3 to 94.4% and solubility in 1.5 to 2.0 volumes of 70% alcohol.

Uses

Mint or 'Pudina' is very popular for use in the common 'Pudina/Dhania' chutney. Mint is also used for flavouring meat, fish, sauces, soups, stews, vinegar, teas, tobacco and cordials. The fresh leaf tops of all the mints are used in beverages, fruit cups, apple sauces, ice cream, jellies, salads, sauces for fish and meats; also to flavour vegetables, chutneys, etc. Roast lamb and mint jelly have become inseparable companions. Japanese mint oil is used as a substitute for true peppermint oil (from *M. piperita*) which resembles it in physico-chemical properties. It possesses a somewhat bitter flavour and is considered inferior to *M. piperita* oil in aroma and quality. *Arvensis* oil with low menthol content is finding some use in cheap perfumery.

Japanese mint oil finds uses similar to that of peppermint oil. However, the latter is preferred for flavouring purposes It is used for the production of natural menthol. Dementholised oil is employed flavouring in mouth washes, toothpastes and pharmaceutical preparations. The main use of mint is the extraction of volatile oil which contains menthol and is used in medicine for stomach disorders, in ointments for headaches, rheumatism and other pains, in cough drops, inhalation, mouth washes, tooth pastes, etc. and also for flavouring in cigarettes. The harsh flavour of *arvensis* is masked to some extent by skilful blending of the two oils. Of course, *arvensis* is not used where delicacy of aroma and flavour is the prime objective.

The oil and the dried plant are antiseptic, carminative, refrigerant, stimulant and diuretic. The dried plant does not have a good taste as it is, but it is expectorant, emmenagogue, tonic to the kidney, useful in the diseases of the liver and spleen, asthma, etc. It also possesses anti-spasmodic properties, is used in jaundice, and frequently given to stop vomiting.

In China, the leaves and stems are made into an infusion and used as carminative, sudorific and antispasmodic. In Annam, the plant is considered as an excellent diaphoretic. An infusion is given in fever, indigestion, etc.

Synthetic menthol is also now being manufactured in a number of countries, but its flavour is not equal to that of the natural one.

MUSTARD

Bot. Name: (1) *Brassica nigra* Koch (*Banarsi Rai*) 'True Mustard' or 'Black Mustard'.
(2) *B. alba* or *B. hirta* or *Sinapsis alba* L or *Safaid Rai* or 'White Mustard'
(3) *B. juncea* (Linn) Czernjajev. 'Indian Mustard' or 'Brown Mustard'.

Family: *Cruciferae*

Hindi, Punjabi and Urdu: *Rai*, *Banarsi Rai*, *Safed Rai*, *Kalee Sarson*; Bengali: *Sarisha*; Gujarati: *Rai*; Kannada: *Sasave*; Kashmiri: *Aasur*, *Sorisa*; Sanskrit: *Asuri*, *Bimbata*; Tamil: *Kadugu*; Telugu: *Avalu*.

Description and Distribution

The genus *Brassica* consists of over 150 species of annual or biennial herbs several of which are cultivated as oilseed crops (as rape, sarson, toria, etc.), or as vegetable or fodder crops. The seeds of only the above 3 species have condiment value. India imported huge quantities of mustard (worth Rs. 3.95 crores) out of the total imports of spices (worth Rs. 4.84 crores), thus constituting about 81 6% of the total spice imports into the country. This provides ample scope for extension of sizeable area under these condimental brassicas in order to put a stop to this heavy drain of valuable foreign exchange.

The oil yielding brassicas which are predominantly cross-pollinated, constitute a group about which considerable confusion exists, regarding their identification and nomenclature.

In India, the principal oil-seed crops are yellow sarson, brown sarson, toria and rai. Punjab rai is grown to a limited extent in the central districts of the Punjab. Banarsi rai and white mustard are also grown to a small extent. The seeds of these two species are used for the preparation of table mustard.

The 'mustard flour' of commerce is a mixture of the flours of two types of mustard seeds; brown or black mustard (*Brassica nigra*) and white mustard (*Sinapis alba*). Its condimental properties are largely due to the essential principles

of these two seeds. The essential principle, or volatile oil, of brown mustard is allyl isothiocyanate, while that of white or yellow mustard is acrimyl isothiocyanate. The essential principles are not present as such in the seeds of brown and white mustards but are produced as a result of hydrolysis of their respective glycosides, sinigrin (potassium myronate) and sinalbin, by the action of the enzyme myrosin, in the presence of moisture under suitable conditions.

In brief, these condimental brassicas are discussed below.

(1) White Mustard (*Sinapis alba or B. hirta*)

White mustard (also commonly called 'yellow mustard') or 'sufed rai' is a self-sterile species, easily recognized by its hairy stem devoid of any bloom. It has irregularly pinnate leaves, large yellow flowers, and spreading, few seeded and hairy pods. These have long empty, knife-like beaks. The seeds are large, white, and lightly pitted and give considerable amount of mucilage with cold water.

S. alba is a native of southern Europe and western Asia. It is grown only as a garden crop, in temperate upper India, during winter. In India, it does not contribute to the supplies of mustard or mustard oil.

Composition

The seeds contain—moisture: 7.2%; protein: 27.6%; crude fat: 29.7%; N-free extract: 20.8%; fibre: 10.3%; and ash: 4.5%.

The seeds also contain the glucoside, sinablin, and the enzyme myrosin. In the presence of water, the latter hydrolyses the former, producing acrinyl isothiocyanate, which is only slightly volatile, sinapine acid sulphate and dextrose. The yield of volatile oil is low, 0.16% only.

Uses

The seeds of *B. alba* are rarely used alone, but they are mixed with black mustard in the preparation of mustard. They are not much used for the extraction of oil. In Europe, the oil cake is used for fattening sheep. Young leaves and tender shoots are used as pot-herb. The species is sometimes cultivated for green manure.

(2) Black Mustard or True Mustard (*B. nigra* Koch)

Black mustard or 'banarsi rai' is highly self-sterile and is quite distinct from other brassicas. The fruits at maturity are closely appressed to the inflorescence axis. The seed coat shows fine reticulations under a lens, and is mucilaginous. The outer epidermis is covered with a thin cuticle. *B. nigra* has been cultivated in Europe since the 13th century and is now reported to be growing wild. It appears to have been introduced only comparatively recently into India and is a cold season crop, grown to a limited extent in UP, Punjab and Tamil Nadu. It does not contribute to the supplies of mustard oil.

Composition

The seeds contain—moisture: 7.6%; N-substances: 29.1%; N-free extract: 19.2%; ether extract: 28.2%; crude fibre: 11%; and ash: 5%. The seeds yield 23-33% of the fixed oil.

The volatile oil of mustard (Sp. gr.: 1.015-1.025; Ref. Index 1.5267-1.5291) is obtained in a yield of 0.7-1.2% after the hydrolysis of the glucoside, sinigrin, by the enzyme myrosin (Indian seeds are reported to yield 0.68% volatile oil). The oil is optically inactive and consists almost entirely of allyl isothiocyanate (93-99%). Specifications for the pharmaceutical oil are (BPC), Sp. gr.: 1.014-1.025; n/20°: 1.525-1.530; and allyl isothiocyanate content: not less than 92%.

For the preparation of volatile oil, the fixed oil is first expressed from the seeds, which are subsequently macerated with tepid water for several hours, and steam-distilled. The oil obtained is an extremely powerful irritant owing to its volatility and penetrating power, and is responsible for the painful nature of alcohol, or in the form with 50 times its volume of alcohol, or in the form rubefacient. It is also used in cases of pleurisy and pneumonia.

Uses

Black mustard is ground with white mustard for preparing table mustard and also various medicinal mustard preparations, such as bath mustard, mustard bran, and mustard flour. The expressed oil has mild rubefacient properties and is used as a liniment. The technical oil obtained during the preparation

of mustard also contains the oil from white mustard seeds. In Europe, it is used for making soap, for burning and as a lubricant. In India seeds of black mustard are used in pickles and curries.

(3) Indian Mustard (*B. juncea*)

Indian Mustard or Rai is a self-fertile species, and is a very variable annual. Its narrow-based leaves are not stem-clasping like those of atoria and sarson. Rai matures later than either. The seeds are rugose, reddish-brown, and generally smaller.

There are two races of rai: a tall, late, and a short, early. The latter is again divided into rough-leaved and smooth-leaved types.

B. Juncea is a common field crop of Bihar, UP and Bengal and is met with in almost all the brassica areas of India. Its cultivation extends westwards to Egypt and Europe and eastwards to China. It is also cultivated in Afghanistan.

By the application of the pure-line method of breeding, the Departments of Agriculture in the Punjab, the UP and Bengal have evolved superior strains suited to the respective provinces. 'R.T. 11' evolved by the Department of Agriculture, UP is claimed to be the most aphid resistant. It has given an average yield of 12-16 cwt with a maximum of 19.0 cwt. per acre.

Composition

The seeds contain—moisture: 6.2%; fat: 35.5%; nitrogenous substances: 24.6%; N-free extract: 20 4%; crude fibre: 8.0%; ash: 5.3%. The oil content of the seeds is usually 30-38%. Certain forms cultivated in the UP and locally known as lahi, lahta, have a higher oil content (42-43%). Commercial rai also contains some sarson. Some samples contain the seeds of var. *crispifolia* Bailey, which resemble those of var. *rugosa*.

Widely varying figures have been given for the volatile oil content of *B. juncea* seeds (upto 2.9%). The volatile oil has the following characteristics—Sp. gr.: 0.995; Refractive Index: 1.5185: Optical Rotation: 0°12′. It is reported to contain allyl isothiocyanate and related compounds, among which crotonyl isothiocyanate has been identified.

Some workers have found only 0.45% of essential oil in

genuine sample of Indian seeds. A re-examination of the volatile oil content of the seeds and of its constituents is necessary.

Uses

Rai is an efficient substitute for black mustard. The USP recognises this species also as mustard. 'Brown mustard' and the expressed oil of mustard prepared from the seeds of *B. juncea* are included in the IPC. The former should contain not less than 0.6% of allyl isothiocyanate.

Preservative Properties: Of the spices, condiments and herbs studied with respect to their effect on yeast fermentation in wines, etc., mustard flour was easily the most efficacious, being followed in order of efficacy by cloves and cinnamon. Little or no preservative action could be detected with cardamoms, cumin, coriander, caraway, celery seed, pimento, nutmeg, ginger, thyme, bay leaves, marjoram, savory, rosemary, black or cayenne peppers. Comparing the stronger of the above preservatives with benzoic acid and sulphur dioxide, it was found that mustard was definitely stronger than either of the two chemical preservatives. Ground cloves had a potency of the same order as that of benzoic acid, and superior to that of sulphur dioxide.

NUTMEG

Bot. Name: *Myristica fragrans* Hout.
Family: *Myristicaceae*
Hindi: *Jaiphal*; Bengali, Gujarati, Marathi, Punjabi and Urdu: *Jaiphal*; Kannada: *Jayikai*; Kashmiri: *Zaaphal*; Malayalam: *Jathikka*; Oriya: *Jaiphala*; Sanskrit: *Jatiphala*; Tamil: *Jathikai*; Telugu: *Jajikai*.

Description and Distribution

As already described under mace, nutmeg is the dried seed

(kernel) of the peach-like ripe fruit of *Myristica fragrans*—the evergreen tree, native of Moluccas and cultivated in Indonesia, West Indies, etc. Indonesia is one of the largest world suppliers of nutmeg. In India, nutmeg is grown on a small scale in Tamil Nadu (Nilgiris etc.) Kerala, Assam and other States, but it is not enough to meet the country's own requirements. Thus, during 1971-72, India imported over 65,000 kg. of nutmeg valued at about Rs. 6 lakhs and in addition nutmeg oil worth about Rs. 1.50 lakhs. There is therefore, an urgent need for putting more area under this crop.

East Indian nuts have the finest aroma. They are ovoid, approximately 2.25 to 2.75 cm long, 1.75 to 2.25 cm in diameter, and longitudinally wrinkled. The colour is grayish brown, with the furrows sometimes white because of liming.

Composition

Comparative analysis of the nutmeg gave the following values —moisture: 14.3%; protein: 7.5%; ether extract: 36.4%; carbohydrates: 28.5%; fibre: 11.6%; and mineral matter: 1.7%; calcium: 0.12%; phosphorus: 0.24%; iron: 4.6 mg/100g; Nutmeg also contains a volatile oil (6-16%); starch 14.6-24.2+); pentosans (2.25%): furfural (1.5%) and pectin (0.5-0.6+). It is only a fair source of vitamins.

The principal constituents are a fixed oil, a volatile oil and starch. The flavour and therapeutic action are due to the volatile oil.

Quality Grades: The following classifications have been adopted in the nutmeg trade—

1. **Whole, sound nutmegs**
   a. Large
   b. Medium
   c. Small

These range from 65 to 110 nuts per pound, the greatest demand being for 80 nuts per pound. These nuts are of interest to the spice trade but usually too highly priced for oil distillation.

2. **Sound Shrivels:** These are employed for grinding but are usually too expensive for oil distillation.

3. Rejections: Considerably lower priced, this grade can be used for oil distillation.

4. Broken and Wormy: This is the cheapest grade, large quantities of which have been shipped yearly to Europe especially to Hamburg, for oil distillation. This quality grade comprises all broken and loosened up nutmegs which seem to contain much less fatty oil than the sound nuts. For this reason, it is very suitable for distilling. The United States customs regulations forbid importation of this grade except for oil distillation. The United States and England import mainly sound nutmegs; Germany (Hamburg) imports the highest and lowest grades, the latter only for distilling: France buys only broken and wormy nutmegs.

Volatile Oil: The comparative physico-chemical properties of oil of nutmeg from different countries are summarised below:

Properties	*East Indian*	*West Indian*	*Travancore Kerala*	*I.P.*
Specific Gravity	0.880-0.913 (at 25/25°)	0.859-0.865 (at 25/25°)	0.890 (at 30°)	0.882-0.910 (at 25°)
Refractive Index	1.408-1.486 (at 20°)	1.4429-1.4446 (at 20°)	1.4445 —	1.4110-1.482 (at 25°)
Optical Rotation	+7.9° to +22.16°	+25 8° to +35.8°	—	+10° to +45°
Acid value	—	—	0.12	—
Ester value (after acetylation)	—	—	46.27	—
Solubility in 90% alcohol	1-2.5 vol. & more	2-3 vol more	—	3 vol.
Evaporation Residue%	0.3-2.1	0.2-0.8	—	max. 3.0

The percentage of volatile oil in nutmeg varies from 6 to 16%, according to the origin and quality of the spice. A sample from Travancore gave 10.2% volatile oil. Wormy nutmegs give a much higher yield thon sound ones; in the former, most of the fixed oil, present in the endosperm which tends to retain the volatile oil during distillation, would have been devoured by worms, while the strongly aromatic oil in the inner layer of perisperm remains intact.

Commercial oil is derived from broken and wormy nutmegs. The material is comminuted, pressed to remove fixed oil, and immediately subjected to steam distillation. Loss of volatile oil from ground nutmegs is relatively rapid (about 80% in 2 months). Cohobation of distilled waters may be necessary for the recovery of the total oil.

Oil of nutmeg is a mobile almost colourless or pale yellow liquid with a characteristic odour. On ageing, it partly resinifies and becomes viscous. The aroma of East Indian oil is much more pronounced and more characteristic of the spice than that of West Indian oils. The latter have lower specific gravity and refractive index and higher optical rotation.

Nutmeg Butter: Nutmeg contains 38-43% of ether extractable material which, in addition to glycerides, contains a volatile oil (6-13%), a small quantity of resin, and a substantial proportion of unsaponifiable material.

Commercial Nutmeg Butter, a highly aromatic fat, is obtained from undersized, damaged or worm-eaten kernels which are unfit for sale as spice. The material is ground and cooked or steamed before pressing. A yield of 24-30% is reported. The fat may be obtained by solvent extraction but this process is not usually employed.

Nutmeg butter is a soft solid (m.p. 38-51°), yellow or yellowish red in colour, with the odour and taste of nutmeg. The analytical characteristics of the commercial product vary a great deal according to the method of preparation and the proportion of volatile oil and resin present. The recorded ranges of values are as follows: % Sp. gr. 20°C: 0.945-0.960; Refractive Index: 1.4662-1.4604; iod. val: 33-65; acid val.: 10-25; sap. val.: 154: 190; and unsapn. matter (containing myristicin): 8-18%.

Leaves: The leaves of *M. fragrans* yield on water-distillation, 0.41-0.62% of a light brown volatile oil (Sp. gr. 20°C: 0.8642; refractive index: 1.474; ester val.: 8.44) with a pleasing spicy odour. Steam distillation of dried leaves (from East Indies) gave 1.56% of a colourless volatile oil. (Sp. gr. at 20°C: 0.8772; Optical Rotation: 3.5°; Refractive Index: 1.4742) containing α-pinene (80%) and myristicin (10%).

Bark : The bark of the tree yields 0.14% of a volatile oil with the following characteristics % Sp. Gravity: 0.871; Optical Rotation: 12.2°; sap. val: 14; ester val. after acetylation: 37.5. A variety of 'kino' is obtained from injuries made in the bark. A volatile oil is obtained also from flowers. The stem contains a tannin-mucilage complex.

Fruit rind. Fresh pericarp from ripe fruit (about 80% of the whole fruit) contains an acidic (23%) astringent juice with an aromatic flavour. Analysis of the fruit rind gave the following values—moisture: 86.8%; protein: 1.0%; ether extract: 0.6%; carbohydrates: 11.2%; and mineral matter: 0.6%; calcium: 0.04%; phosphorus: 0.01%; iron: 2 mg/100g and carotene (as vitamin A): 8 I.U./100g.

Adulteration: Nutmegs are sometimes adulterated with 'false' nutmegs (*M. malabaricum*) or Bombay nutmegs which are practically odourless and tasteless. Its detailed description is given in *Wealth of India*.

The oil is sometimes adulterated by additions of turpentine oil or pinene, limited amounts of which scarcely affect its physical and chemical constants. Since pinene is a natural constituent of nutmeg oil, it is difficult to detect moderate additions by chemical means. An expert will employ organoleptic tests in the evaluation of this oil.

Uses

Both nutmeg and mace are used as condiment and in medicine. In eastern countries, they are used more as a drug than as condiment. Nutmeg is stimulant, carminative, astringent and aphrodisiac; it is used in tonics and electuaries and forms a constituent of preparations prescribed for dysentery, stomach ache, flatulence, nausea, vomiting, malaria, rheumatism, sciatica and early stages of leprosy. Excessive doses have a narcotic effect; symptoms of delirium and epileptic convulsions appear after 1-6 hours. Mace is similarly used, it is also chewed for masking foul breath.

Oil of nutmeg or mace is employed for flavouring food products and liquor. It is used for scenting soaps, tobacco and dental creams, and also in perfumery. It is mildly counter-irritant and used in liniments and hair lotions. It has been

recommended for the treatment of inflammations of bladder and urinary tract, the oil is somewhat toxic owing to the presence of myristicin and should be used with caution.

Nutmeg butter is used as a mild external stimulant in ointments, hair lotions and plasters and forms a useful application in cases of rheumatism, paralysis and sprains. It is used in perfumes for imparting a spicy odour and in the manufacture of soaps and candles. Nutmeg butter is sometimes substituted by fats from other Myristica spp.

Alcoholic extracts of nutmeg show anti-bacterial activity against *Micrococcus var. aureus*. Aqueous decoctions are toxic to cockroaches. Myristicin present in the kernel may be employed as an additive to pyrethrum to enhance the toxicity of the latter to houseflies; myristicin by itself is inactive. The volatile oil from the leaf has weedicidal properties. It may also be used for scenting soaps, dentifrices, chewing gums and tobacco. It is not produced on a commercial scale.

The *pericarp* or rind of the ripe fruit is locally used in pickles; it is used also in the preparation of jellies. Half-ripe fruits are candied in Malaysia. In author's laboratories, nutmeg rind was found to be a rich source of good quality pectin (12.14%) of 150-175 jelly grade. After suitable processing/curing, the rind has also been used in the manufacture of beverages, jelly, candy, jam, mixed jam, in canned fruit cocktoil oil and vinegar pickles alone or mixed, etc.

ONION

Bot. Name: *Allium cepa* Linn.
Family: *Liliaceae*
Hindi, Punjabi and Urdu: *Piyaz*; Assamese: *Piyaz*; Bengali: *Palandu*; Gujarati: *Dunzari*; Kannada: *Nirulli*; Konkani: *Kandu*; Malayalam *Bawanj*; Marathi: *Kanda*; Sanskrit: *Palandu*; Sindhi: *Dungari*; Tamil: *Vengayam, Irulli*; Telugu: *Nirulli*.

Description and Distribution

Onion is too well known to need any description. It is used both for cooking and as a condiment for flavouring or for pickling. It is grown practically all over India. In fact, India is one of the world's largest producers of onion and has been exporting onions worth Rs. 50-58 crores annually to South East Asian countries. Admittedly, onion is one of the most important commercial vegetable crops of India. Among the bulb-crops, onion is by far the most important, and occupies about 266,900 hectares; (Annexure IIA). it deserves our serious consideration for further extension of area under improved varieties which are disease-resistant, high yielding, and are of good quality and good keeping quality.

Mild onions are used for cooking or as salad. Pungent varieties are used as condiment for flavouring a number of foods. Pearl onions or small onions are used in pickles. including vinegar pickles. For dehydration purposes and for manufacture of onion powder, white onions of desired quality are preferred. The desirable traits needed in onions for dehydration are (*i*) white coloured flesh, (*ii*) full globe to tall global shape of bulbs with 5-6 cm diameter, (*iii*) solids content around 15%; preferably 20%, (*iv*) high degree of pungency, (*v*) high yield, (*vi*) good keeping quality (at least 2-3 months), (*vii*) freedom from joints, (*viii*) disease free, etc.

Dehydrated onions, onion flakes, kibbled onions and onion powder are used for flavouring ketchups, sauces, etc.

Onion Powder is prepared by grinding the dehydrated onion slices in hammer mill to a suitable mesh. It is highly hygroscopic and hence the important precaution regarding its storage is to keep it in air-tight containers in a cool, dark and dry place failing which it may absorb moisture, become granular, cakey, pasty and ultimately get mould attack.

Onion salt is prepared by mixing 19-20% onion powder with 78% free flowing pulverised refined table salt and 1-2% anti-caking agent which prevents water absorption, and caking etc.

Composition

Onion (big) contains—moisture: 86.8%; protein: 1.2%; fat: 0.1%; carbohydrates: 11.6%; calcium: 0.18%; phosphorus:

0.005; iron: 0.7 mg/100g. The bulbs and fresh herb yield 0.005% of an essential oil (Refractive Index: 1.041; Optical Rotation −5°) which has an acrid taste and unpleasant odour. The chief constituent of the crude oil is allyl-propyl disulphide.

Composition of onion powder is—moisture: 4.6%; protein: 10.6%; fat: 0.8%; fibre: 8.4% carbohydrates. 74.1% mineral matter (total ash): 3.5%; calcium: 0.3% phosphorus: 0.29%; sodium: 0.04%; potassium: 1.0%; iron: 0.002%; vit. A: 175 I.U./100g; vit. B_1: 0.42; vit. B_2: 0.06; nicotinic acid: 0.6%; vit. C: 14.7 mg/100g. Calorific value: 370 calories/100g.

Uses

Because of the presence of several sulphur compounds, onion has antiseptic properties.

Onion is said to possess stimulant, diuretic and expectorant properties and is considered useful in flatulence and dysentery. Freshly expressed onion juice has moderate bactericidal properties.

Onions are used as salad, cooked in several ways in all types of curries; they are baked, boiled, fried and used in fresh or dehydrated or powder form in soups, pickles, sauces, etc. They are also eaten raw as a salad.

ORIGANUM

Bot. Name: *Origanum vulgare* Linn.
Family: *Labiatae.*
Hindi: *Sathra*, *Mirzanjosh*; Punjabi and Urdu: *Mirzanjosha.*

Description and Distribution

Origanum, Oregano, Mexican Origanum or wild marjoram of trade is the dried leaves of an aromatic branched perennial herb, 30-90 cm high, found in the temperate Himalayas from Kashmir to Sikkim, at altitudes of 1500-3600 m. Leaves

broadly ovate, entire or rarely toothed; flowers purple or pink in corymbose cymes; nutles smooth, brown. Oreyano is cultivated in Greece and Italy. It grows abundantly in Mexico and is also known as Mexican sage. Origanum is a perennial herb of the mint family. *O. vulgare* is very common is Simla Hills and in Kashmir valley. It is hardy and can be grown in all warm garden soils. It is propagated by seeds, cuttings, layers and root-division. It can be sown during October in the plains and during March and April in the hills.

The colour of the dried herb is light green. The aroma is strong, aromatic, camphoraceous and resembles that of marjoram. In fact, the Spanish word *Oregano* means 'marjoram'. The taste is fragrant. spicy, warm, pungent and bitter. According to some, the properties of Mexican origanum resemble those of sage rather than those of marjoram. The plant owes its usefulness as a culinary herb to its volatile oil.

Composition

Moisture: 8.0%; protein: 11.7%; fat: 6.4%; crude fibre: 11.0%; carbohydrates: 53.9%; total ash: 9.0%; acid insoluble ash: 1.0%; calcium: 1.7%; phosphorus: 0.20%; iron: 0.05%; sodium: 0.02%; potassium: 1.7%; vit. A: 1010 I.U. per 100g; vit. B_1: 0.34; vit. B_2: 0.41; niacin: 6.2 and vit. C: 12 mg/100g. Calorific Value (food energy) is 360 calories/100g.

Volatile Oil: Origanum also contains volatile oil, fixed oil, cellulose, pigment and mineral elements. Oil of origanum appears to be made under this name from a number of related species of Labiatae plants. In some origanum oils, thymol is the main constituent; in others, carvacrol. Botanists and herb growers classify it as the 'pizza herb'.

The herb contains a volatile oil (0.15-0.40%), tannin (about 0.8%) and a bitter principle. The oil of European origin (Specific gravity at 15°C: 0.868-0.910; Optical Rotation:—20° to 70°) possesses an aromatic spicy somewhat basil-like odour and contains thymol (upto 7%), carvacrol, free alcohols about (13%), esters as geranyl acetate (2-3%) and bicyclic sesquiterpene (12.5%). Steam distillation of the whole plant from Kashmir gave a pale yellow oil (yield 0.2%) with a pleasant smell and the following characteristics—Specific gravity at

27°C: 0.8812; Refractive Index at 27°C: 1.4795; Optical Rotation:— 1.5°; acid val.: 2.5; ester val.: 10.4; (after acetylation: 102.7); phenol content: nil; freely soluble in 90% alcohol. It contains dl. pinene, dipentene, linalool, bi-and tri-cyclic sesquiterpenes and palmitic acid. The oil called oil of origanum in trade is really thyme oil (from *Thymus vulgare* L).

Oil of *O. vulgare* is often confused with sweet marjoram oil (from *Majorana hortensis*) which is, however, dextro-rotatory (upto +40°).

Uses

Oregano is an essential ingredient of chilli sauce, and is used in Chilli con Carne and many other Mexican dishes. It is the spice that made pizza famous and is equally good in any tomato-type dish, from spaghetti to old-fashioned stewed tomatoes. Origanum is also used for flavouring soups, meat dishes, pork, fish, egg dishes and salads.

It is reported that no Mexican kitchen is without oregano since they contend that no other herb communicates such excellent aroma and flavour to food. The leaves and tops prior to blooming are used to flavour foods in the same way as sweet marjoram (*Majorana hortensis*). The plant is used in the Punjab as a pot herb, it is eaten also as vegetable in Laboul. It was formerly employed to flavour ale and beer before hops were introduced in the brewing industry.

Medicinal Uses: The oil possesses carminative, stomachic, diuretic, diaphoretic and emmenagogue properties: it is given as a stimulant and tonic in colic and diarrhoea; it is also applied in chronic rheumatism, tooth-ache and ear-ache. Due to spasmolytic action of the oil, it is used in whooping cough and bronchitis. In homeopathy, it is used for hysteric condition. It is used as an external application in healing lotions for wounds, usually in conjunction with other herbs. The oil has been employed in veterinary liniments. It is used in gargle and bath. It stimulates growth of hair. The oil is used in the cosmetics and soap industries.

Other Uses: The herb is stated to be cultivated in Poland for its seeds from which a fatty oil is extracted with a yield of 29.2%.

PARSLEY

Bot. Name: *Petroselinum crispum* (P. Miller) Nymann ex. A.W. Hill.
Family: *Umbelliferae*
Hindi: *Ajmood;* Kannada: *Achu mooda;* Malayalam: *Kothambelari.*

Description and Distribution

Parsley, a native to Sardinia, wildly and extensively cultivated in the Mediterranean region and the U.S.A. is a hardy, aromatic biennial umbelliferous herb, sometimes lasting upto 4 years, producing a rosette of finely divided radical leaves in the first year and a flowering stalk, upto 100 cm high in the second. It has rich green compound leaves 2 or 3 pinnate. Flowers yellow or yellowish green in compound umbels; fruit (commonly known as seeds) 2-3 mm long, crescent shaped, conspicuously ridged, consisting of two mericarps. Leaves and seeds are used as a spice. The colour of the dried herb is green. Its aroma is pleasant, characteristic, fragrant, and spicy. Dried herb is available as whole, rubbed or ground form.

There are two main types of horticultural parsleys: those cultivated for the leaves *(var. crispum)* and those grown for their turnip-like roots *(var. radicosum* Danert). Only the former type of parsley is cultivated in India. In the latter case, roots are cut after the fruits (seeds) are harvested. The roots are sliced longitudinally to facilitate drying. The seeds are used for the extraction of parsley oil of commerce. Of course, the aroma of seeds is less than that of leaves. 2-5 cuttings of leaves are possible for each planting before flowering. Within the leafy varieties, parsley has been developed into 3 types of foliage, viz. (i) plain foliage (ii) the double curled leaf, and (iii) the moss curled or triple curled leaf. The fleshy-rooted parsley has plain celery-like leaves.

Parsley is a cool weather crop, growing best in a rich moist soil, amenable to deep cultivation. In this country, the herb grows better at higher altitudes. It is grown occasionally in

gardens. Sowing is done in March-May on the hills and August to November in the plains.

Composition

Analysis of the green leaves gave the following values—moisture: 68.4%; protein: 5.9%; fat: 1.0%; carbohydrates: 19.7%; fibre: 1.8%; and mineral matter: 3.2%; calcium: 390 mg; phosphorus: 200 mg/100 g; iron: 17.9 mg%; carotene (as vitamin A): 3,200 I.U., thiamine: 0.04 mg; nicotinic acid; 0.5 mg. and vit. C (ascorbic acid); 281 mg/100g. The vitamin A content ranges as high as 2,230 I.U./100g.; riboflavin and biotin are also present.

The leaves, stems and fruits contain a glucoside apiin which on hydrolysis yields apigenin, glucose and a sugar; apiose: a second glucoside, consisting of luteolin, glucose and apiose has also been reported. The fruits of plants from Delhi yielded 2.2% of apiin, but the second glucoside could not be detected.

Volatile Oil: All parts of the plant contain an essential oil, Oil of Parsley, which is responsible for the characteristic aroma and flavour of parsley. The oil is recovered by steam-distillation and is used mainly for flavouring food products. The oil obtained from the flowering tops is of the finest quality, truly representing the odour of the leaves, but the yield is too low (0.06%) for commercial production. Commercial parsley oil is distilled either from the aerial parts of the herb bearing immature fruits (herb oil, yield about 0.25%) or from the mature fruits (fruit oil, yield upto 7%). The herb oil possesses a superior aroma and is more esteemed than the fruit oil. There is considerable difference in the physico-chemical characteristics of the herb and seed oil. The fruit (seed) oil contains apiol (parsley camphor) and α-pinene, with small amounts of myristicin, aldehydes, ketones and phenols. The herb oil is reported to contain apiol but no detailed investigation appears to have been undertaken. The apiol is used medicinally for the same purposes as the herb. but is of doubtful therapeutic value. Commercial apiol is frequently adulterated with tri-o-cresyl phosphate, which may have severe toxic effects.

Fatty Oil: The fruits yield about 20% of a greenish fatty oil with a peculiar odour and disagreeable sharp flavour. The

oil has a high content of petroselinic acid (upto 76%). It can be tried for a variety of industrial purposes, such as making of plastics, synthetic rubber, lubricating oil additives and protective coatings.

Uses

Fresh leaves mask even strong culinary odours and are commonly used for garnishing and seasoning; they are eaten fresh, incorporated in salads, and used as an ingredient of soups, stews and sauces. They are also used in meat and poultry seasonings. The leaves are also employed to make a sort of tea which is considered to possess anti-scorbutic properties since it is a very rich source of vitamin C (281 mg/100g.)

The roots are used as a vegetable in soups. The dried leaves and roots are used as condiments, but the use of fruits for this purpose has been contradicted by some authors. The fresh leaves are a good source of iron, calcium, carotene and vit. C or ascorbic acid (upto 460mg/100g).

The herb is reported to possess diuretic, carminative, ecbolic, emmenagogue and antipyretic properties, and has long been in use for uterine troubles. The juice of the fresh leaves is used as an insecticide. Parsley causes skin reactions in some people, and this is attributed to the presence of a furocoumarin, bergapten. Bruised leaves are applied to bites and stings of insects, and the mericarps are used to get rid of lice and skin parasites. Extracts and infusions of leaves and roots on subcutaneous administration in mice produced a depressing effect on the nervous system.

In a series of experiments conducted on hearts of frogs, cats and rabbits, it was noted that small dose (2 drops) of 1% aqueous infusion of leaves increased the amplitude and slowed cardiac contraction; large dose (5-10 drops) of 10% leaf infusion was followed by depression of cardiac activity. Intravenous administration of the infusion as well as the extract caused fall in blood-pressure and dilatation of the blood vessels. Rabbits and guinea pigs when treated with increasing oral doses of apiole during gestation period, usually abort and die after 26-28 days. Apiole is also known to cause poisoning and

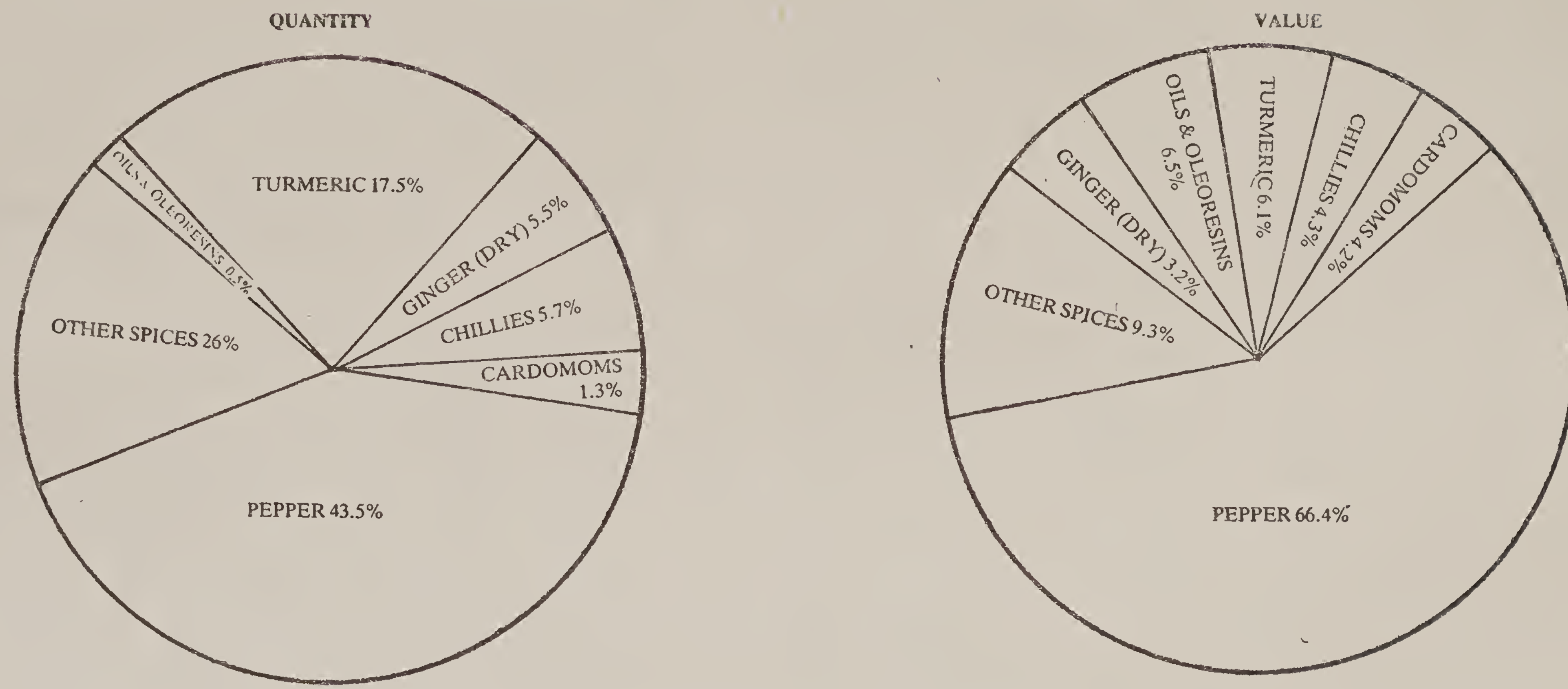


Fig. 2. Share of export of different spices during 1988-89

sometimes fatal lesions in liver and kidney. Hence, a cautious use of parsley oil is called for.

BLACK PEPPER

Bot. Name: (i) Black pepper: *Piper nigrum* Linn.
(ii) Green Pepper: *P. nigrum* Linn.
(iii) White Pepper: *P. nigrum* Linn.
Family: *Piperaceae*
Hindi: *Kali Mirch;* Bengali: *Kala morich, Golmarich;* Gujarati: *Kala Mari, Kalomirch;* Kannada: *Kare Menasu;* Kashmiri: *Marutis;* Malayalam: *Kurumaluku, Nallamulaku;* Marathi: *Mire, Kali Mirch;* Oriya: *Gol-maricha;* Punjabi: *Kali Mirch;* Sanskrit: *Maricha Ushana, Hopusha;* Tamil: *Milagu;* Telugu: *Miriyalu;* Urdu: *Kali Mirch* or *Siah Mirch.*

Description and Distribution

Black Pepper or Kali Mirch is known to one and all due to its day-to-day use as one of the most popular spices. Black pepper is rightly considered the 'King of Spices' as judged from the volume of international trade, being the highest among all the spices known. In India too, during 1989-90, it earned us the valuable foreign exchange (Rs 160 crores) out of the total exchange earnings of over Rs 274.4 crores through all the spices exported from India. (*See* Annexure 1).

In the recent past, India supplied 70-80% of the total world requirements but now the figures have come down to about 20% because of fierce competition from other countries. During 1988-89, pepper alone earned about 66.4% of the total foreign exchange of earnings of over Rs 274 crores from the export of all spices, curry powder, oil and oleoresins. (*See* Fig. 2).

Black pepper is the dried mature but unripe berries (fruit) of *P. nigrum*, a branching vine or climbing perennial shrub mostly found in hot and moist parts of southern India notably

Kerala (alone contributing about 96% of India's total production) and Karnataka (3.5%) and the rest in Tamil Nadu and Pondicherry. It is one of the most ancient crops cultivated in India and has probably originated in the hills of south-western India where it is met with in the wild state in the rain forests—from North Kanara to Kanyakumari. It is also cultivated in Indonesia, Malaysia, Sri Lanka, Brazil, Thailand and other tropical countries.

There are many varieties/types of black pepper known in the world trade. They take their names from the localities where grown or from the ports through which they are exported, e.g. Tellichery, Malabar, Alleppey (Kerala), Lampong, Saigon, Penang and Singapore. These peppers differ slightly in their physical and chemical charactertistics, colour, size, shape, flavour and bite. Tellichery and Alleppey peppers are large, attractive, dark reddish-brown to black, very aromatic and among the best varieties, as also the 'Malabar Garbled' (MG_1) which alone accounts for nearly 90% of the total exports from India. Lampong and Singapore pepper are smaller, more shrivelled but almost equally pungent.

There are nearly 24 varieties/types of black pepper grown in India and their identification is rather difficult, since some of them go by different names in different regions. There is considerable scope in evolving crosses or hybrids combining important quality attributes like high yield, hardiness, disease resistance, long spikes with good fruits (berries) compactly set all over. Some good crosses have been recently evolved at the Pepper Research Station, Panniyur (Kerala), notably hybird Panniyur-I which has been found to be quite promising.

The spikes/fruits are ready for harvest when they are fully mature and start yellowing or become yellowish. At this stage, whole spikes are removed from the vines with the aid of ladders. The spikes are kept for a day or so, where the berries are removed by rubbing or scrubbing and dried in the sun or the spikes are directly dried in the sun for a few days on mats or on clean concrete floors. They are turned over and, later, berries are removed by rubbing, threshing or trampling. When completely dry, the outer skin of the berries becomes dark brown to black and gets shrivelled.

Generally 100 kg of fresh berries yield about 26-39 kg of black pepper of commerce. Of course, the yield of pepper varies widely in different producing areas depending upon several factors such as elevation, temperature, distribution of rainfall, soil fertility, cultural practices, type or variety of pepper, and age of the pepper vine, etc. In India, the yield varies from 110 to 335 kg per hectare. (Av. 251 kg/ha) (See Annexures I, II and II A).

In addition to black pepper, pepper is also sold in the following processed forms: White Pepper and Processed Green Pepper. Their brief descriptions and methods of preparation are given below :

(1) White Pepper

White and black pepper are prepared from the berries (fruits) of the same plant or species (*P. nigrum*). The only difference is that for preparing black pepper, spikes are harvested when berries are fully mature, but unripe, i.e. when green or greenish yellow, but for preparing white pepper, the harvesting of berries is delayed until they become ripe i.e. yellowish red or red.

White pepper is prepared by removing the outer pericarp (skin) of the harvested berries, either before or after drying by any one of the following technique:

(a) Water-steeping technique:

(i) using ripe fresh berries.

(ii) using dried berries.

(b) Steaming or water-boiling technique.

(c) Decortication technique.

(a) Water-steeping technique

(i) Using ripe fresh berries: This is the old indigenous technique according to which the harvested ripe spikes or berries removed therefrom are packed in gunny bags and steeped as such in water tanks or under running water for 7-10 days. The pin-heads (tiny undeveloped berries) and light berries float and are separated, dried and sold as 'pin-heads' and 'light pepper.' The remaining bigger berries are stirred 2-3 times daily. On the 11th day, they are heaped on a tarpaulin and rubbed by hand or trampled to remove the outer softened skin.

The de-skinned berries are then washed, drained and put into a galvanized iron vessel containing a solution of bleaching powder. The de-skinned berries are kept immersed there for 2 days whereafter they are removed, drained, dried in the sun, cleaned and sold as 'white pepper.'

(ii) **Using dried berries:** The dried black pepper berries are steeped in water for 10-15 days, whereafter they are removed, rubbed, washed thoroughly, steeped again in bleaching solution for 2-3 days, drained, dried in the sun and sold as white pepper. However, the white peppèr is more easily prepared from fresh ripe pepper than from dried black pepper.

(b) **Steaming or boiling technique:** This is an improved and more hygienic technique developed at the Central Food Technological Research Institute, Mysore. This simple modern process consists in steaming or boiling of fresh mature ripening berries for about 15 minutes. The boiled or softened berries are then passed through a motorized fruit pulping machine for removing their outer-skin. The de-skinned berries are then washed and bleached with bleaching powder solution or any other bleaching chemical, as usual. Thereafter, the bleached white berries are removed, drained and dried in the sun to get white pepper.

The skins of the berries get collected at the other end of the machine and are immediately utilized for steam distillation for the recovery of valuable 'pepper oil' which constitutes an important by-product and thus provides this improved process an edge over all other techniques.

(c) **Decortication technique:** White pepper is also prepared by decorticating (mechanical removal of skin) of dried black pepper berries in special decorticating machines. The major drawbacks of decortication process are (i) large breakage of berries, (ii) lack of uniformity in shape and surface. This technique is used in Indonesia.

Of the total world production of 70-75 thousand tons of pepper, about 25% is in the form of white pepper. However, India does not produce and export white pepper on a large scale. Only on a limited scale, "Tellicherry white bold pepper" is exported at times, which has earned considerable

international fame. It is also prepared on a domestic scale for medicinal and home use.

As in the case of black pepper, different varieties of white pepper take their names from the localities where grown and produced or from the ports through which exported. Good grades or varieties best known to the world of commerce are Singapore, Muntok, Siam, Sarawak and Tellicherry (Kerala). Tellicherry white pepper is very highly esteemed abroad and is in great demand but in short supply.

(2) Processed Tender Green Pepper

Tender green pepper spikes harvested when semi-mature or fallen spikes are often sold in market for use in pickles. Besides, process for canning of tender green pepper berries (whole, destemmed or with stem) in 2% brine (common salt solution) in different sizes of cans, has been standardized at the Trichur Experiment Station of Central Food Technological Research Institute now at R.R.L., CSIR Trivandrum. The optimum stage of maturity for harvesting for canning and processing purposes has been determined, which prevent the triple problems of cloudiness in brine, rupturing of berries and sedimentation, etc. Based on these researches, processed tender green pepper worth about Rs 32 lakhs was exported during 1982-83. It may be noted that processed (canned) green pepper fetches about 10 times the price of black pepper and thus offers a new promising line for diversification of exports of pepper.

Besides, methods of preparing different types of green pepper pickles in brine (12-16%), vinegar, oil and in conjunction with other pickling materials like tender green mangoes, green ginger, green chillies, etc. have been evolved.

The season of availability of tender green pepper is only 2-3 months. In order to extend its season of availability, a simple novel technique has also been developed at Trichur Experiment Station of CFTRI (now at Trivandrum) for dehydration of green pepper which can be stored for a year or more and can be used at will by simple reconstitution (steeping in water) as in the case of dried green peas or dried green gram. There are good prospects for the development of this industry in India.

Composition

Analysis of 23 types of black pepper from Kerala, South and North Kanara, Coorg and Assam gave the following ranges of values—moisture: 8.7-14.1%; total nitrogen: 1.55-2.60%; nitrogen in non-volatile ether extract: 2.70-4.22%; volatile ether extract: 0.3-4.2%; non-volatile ether extract: 3.9-11.5%; alcohol extract: 4.4-12.0%; starch (by acid hydrolysis): 28.0-49.0%; crude fibre: 8.7-18.0%; crude piperine: 2.8-9.0%; piperin (spectrophotometrically): 1.7-7.4%; total ash: 3.9-5.7%; and acid insol. ash (sand): 0.03-0.55%. The Kerala types, particularly Kottanadan, Kumbhakodi and Kuthiravali, are fairly high in crude piperine, while the North Kanara types show low values for piperine. Assam types are characterised by a low moisture content, high ether and alcohol extractives and consistently high values for total nitrogen and piperine. Thus numerous types of Indian black pepper are characterized by variations in size, colour, flaour and physico-chemical properties. The bulk density of pepper varies with the type of pepper. Examination of 82 samples, belonging to different localities, showed that their bulk density ranged between 426 and 850g/litre, the Tellicherry and Baliapatnam types showing the highest values.

Starch is the predominant constituent of pepper. It accounts for 34.8% in black pepper, 56.5% in white pepper and 63.2% in decorticated white pepper. Pepper starch consists of minute polygonal granules resembling those of rice, but much smaller (diam.: 0.5-5μ). The helum is visible only under high power magnification.

Protein of pepper has not been fully investigated. A considerable portion of nitrogen in pepper exists in a non-proteinous form (such as alkaloids). Of the 12% of water-soluble nitrogen, non-protein nitrogen constitutes about 82% and of this, more than half is made up of simple amino acids which can be readily utilized by the human system.

Pungent Principles: The alkaloid piperine (m.p., 129-30°) is considered to be the major constituent responsible for the biting taste of black pepper; it is absent in the leaves and stems of pepper and stems of pepper plant. Piperine is sparingly soluble in water, readily soluble in alcohol, and on hydrolysis

splits into piperidine and piperic acid. Piperine is at first tasteless but on prolonged contact develops a sharp biting taste: alcoholic solution of piperine is intensely pungent. Other pungent alkaloids, occurring in pepper in smaller amounts, are chavicine, piperidine and piperetine. Chavicine, a resinous isomer of piperine, is said to be the most biting ingredient of pepper, and on hydrolysis, yields piperidine and isochavicinic acid (an isomer of piperic acid).

Piperine is stated to occur in pepper in amounts usually ranging from 4 to 10% but this amount represents crude piperine, the content of true piperine being lower. Among the methods described in literature, the spectrophotometric methods gives the best results for the quantitative estimation of piperine.

Oil of Pepper: The characteristic aromatic odour of pepper is due to the presence of a volatile oil in the cells of pericarp. On steam distillation, crushed black pepper yields 1.0-2.6% (upto 4.8%) of the volatile oil, the yield depending greatly upon the age of the dried fruits subjected to distillation. For the production of the oil, the lower priced qualities of pepper, damaged or broken fruits and pepper hulls (obtained as a by-product in the preparation of white pepper) serve as economic raw material. They are distilled as fresh as possible to avoid loss of the oil during storage. White pepper is seldom used for commercial distillation of volatile oil since it is costlier and also the hulls where the oil is mostly concentrated, get removed during its preparation; the oil content in a fresh sample of white pepper is about 0.95%. The pepper powder left after extraction of the oil can be employed for culinary purposes and also for extracting the oleoresin.

Oil of pepper is an almost colourless to slightly greenish liquid with a characteristic odour of pepper and also of phellandrene. The oil has a mild but not pungent taste, and has the following range of values—Sp. gr. 15°C: 0.873-0.916; Optical Rotation: $-10°$ to $+3°$; Refractive Index: 1.480-1.499; Acid val: upto 1.1; Ester val.: 0.5-6.5; Ester val. after acetylation: 12-22.4; sol. in 10-15 vol. of 90% alcohol and 3-10 vol. of 95% alcohol.

Pepper siftings and dust (refuse obtained during the drying or garbling of pepper) are also sometimes distilled to yield

inferior oils having harsher and coarser odour and flavour than those from sound fruits. Siftings gave 1.44% and dust 0.85% of the oil having the following characteristics respectively—Sp. gr. 15°C: 0.911, 0.911; Optical Rotation: −1.3°, −2°; Refr. Index at 20°C: 1.4961, 1.4980; Sap. val.: 7.5, 2.8; phellandrene test negative in both the cases.

Oil of pepper consists chiefly of the terpenes, 1 phellandrene, caryo-phyllene, and perhaps dipentene. The characteristic odour of the oil has been attributed to the presence of small amounts of oxygenated compounds (about 0.5% in the oil).

Adulteration: Oil of pepper is occasionally adulterated with the lower priced common adulterants like phellandrene, dipentene and caryophyllene which are also natural components of the oil itself. Hence, their conclusive detection is very difficult by chemical tests. Their presence can be detected by careful odour and flavour tests by experienced hands.

Apart from the dust, dirt, stems, chaff or similar organic extraneous matter, pepper berries are also sometimes adulterated with papaya seeds which can be detected under a hand magnifying lens or by cutting the suspected seeds into halves. Papaya seeds show a line while black pepper berry exhibits only a central hole since the former is a dicot and the latter, a monocot.

Ground pepper is adulterated with ground pepper shells and or farinaceous (starchy) matter which can be detected with difficulty under the microscope. The best course is to always buy whole, sound berries and get them ground at home, with a coffee-grinder (hand operated or motorised).

Pepper by-products: Three different by-products are available in the market viz. the pepper rejections or waste *varagu* or the unfertilized buds, and the stems and inflorescence stalks. Varagu and stalks are poor in ether soluble fractions and have a high content of crude fibre: Pepper rejections, however, are rich in the bite factor and can be used for preparation of the oleoresin. In order to economise the use of pepper as a condiment and replace it in times of scarcity, many products having the characteristic taste and pungency of pepper have been prepared by patented processes, particularly in the USA. Berries of low specific gravity but rich in oleoresin have been

extracted with solvents for further processing into spice pastes. A homogeneous solution of the oleoresin (contains about 50% of piperine and resins and 50% of essential oil) has been prepared for use in salad dressings. A patent has been taken out by CFTRI, Mysore (CSIR) for the preparation of a new flavouring substance named 'Pepper-sal' from waste black pepper (rejections) and common salt. Pepper-sal has found acceptance as a flavouring agent for salads, drinks and meat dishes.

Pepper hulls: Pepper hulls, or shells removed during the preparation of white pepper, are sold separately as a light to dark brown powder with a very pungent odour and taste, and has been found useful for flavouring tinned foods. Pepper shells are rich in volatile oil and can be used as a source of pepper oil.

Uses

Pepper is used for a variety of purposes. The ancient Aryans considered it as a powerful remedy for various disorders of the anatomical system and prescribed it as an effective cure for dyspepsia, malaria, delirium, tremors, hemorrhoids, etc. The Egyptians used it for embalming. The Asians are said to have used it as an aphrodisiac. The Dutch and French housewives use it as an insect-repellant and moth killer! However, its value as an essential preservative for meats and other perishable foods has been known for centuries. It is, therefore, largely used by meat packers and in canning, pickling, baking, confectionery and preparation of beverages. One of the principal values of pepper is its ability to correct the seasoning of dishes. Just before the end of cooking, a final dash of pepper can be used effectively to adjust the flavour.

Piperine, the bite factor of pepper, has no marked physiological action and is no longer used in medicine. However it possesses some feeble anti-periodic property. Piperine has been used to impart a pungent taste to brandy. It has also been tried as an insecticide. It is stated to be more toxic to houseflies than pyrethrum, and a mixture of 0.05 per cent piperine and 0.01 per cent pyrethrins is more toxic than 0.10 per cent pyrethrins alone.

Oil of pepper is a valuable adjunct in the flavouring of sausages, canned meats, soups, table sauces and certain beverages and liquors. It is used in perfumery, particularly in bouquets of the oriental type to which it imparts spicy notes difficult to identify. The oil is also used in carnation compound for soaps. It finds uses in medicine. A mixture of the volatile oil and resin, prepared by extracting pepper with ether was formerly official in USP. Oils of black and white pepper appear to contain growth stimulants for yeasts.

Black pepper constitutes an important component of culinary seasonings of universal use and an essential ingredient of numerous commercial food stuffs. It is an important constituent of whole pickling spice and many ground spice formulae of seasonings, etc. for poulrty dressings, sausages, hamburger and frankfurter seasonings.

White pepper commands a higher market price for use in such products as mayonnaise where the black specks of black pepper are not liked.

LONG PEPPER

Bot. Name: *Piper longum* Linn.
Family: *Piperaceae*
Hindi & Punjabi: *Pipli*, *Piplamul;* Assamese: *Piplu*, *Pipal;* Bengali: *Piplamore* (root), *Pipli;* Gujarati: *Pipli;* Kannada: *Hippali*, *Hippalibali*, *Kuna;* Malayalam: *Tippali*, *Pippuli;* Marathi: *Pimpli;* Oriya: *Pippoli;* Sanskrit: *Pippali;* Sindhi: *Pippli*. Tamil: *Thippli;* Telugu: *Tippili*, *Pippallu;* Urdu: *Pipul*.

Description and Distribution

Long pepper is the dried fruit of *Piper longum* L, which is a slender aromatic climber with perennial woody roots occurring in the hotter parts of India, from Central Himalayas to Assam, Khasi, and Mikir hills, lower hills of Bengal, and evergreen

forests of the Western Ghats from Konkan to Travancore: it has been recorded also from Nicobar Islands. Stems creeping, jointed; young shoots downy; leaves 5-9 cm long, 3-5 cm wide, ovate, cordate with broad rounded lobes at base, spikes cylindrical pedunculate, male larger and slender, ovoid, yellowish orange, sunk in fleshy spike.

India imports a large quantity of long pepper from Malaysia and Singapore. Thus, during 1981-82, the total imports amounted to 2,20,312 kg valued at nearly Rs 6.1 lakhs. A small quantity of long pepper has been exported in some years to Afghanistan, Sri Lanka and Pakistan.

Indian long pepper is mostly derived from the wild plants, the main sources of supply being Assam, West Bengal, Nepal and Uttar Pradesh. Small quantities are also available from evergreen forests of Kerala, West Bengal and certain parts of Andhra Pradesh. It is reported to be cultivated at low elevations in the Anamalai hills in Tamil Nadu and parts of Assam, particularly in the Cherrapunji area. Long pepper is cultivated on a large scale in limestone soil, 450-600m below the Cherrapunji region which receives very heavy rains from the end of March to the middle of September and where the relative humidity is high.

Composition

Recent work on the fruit of *P. longum* has shown the presence of the alkaloids, piperine (4-5%) and piplartine (m.p. 124-25°%); and two new liquid alkaloids, one of which is designated as alkaloid A. This is closely related to pellitorine producing marked salivation, numbness and a tingling sensation of mucous membranes of the mouth.

Volatile Oil: A sample of dried fruit of long pepper on steam distillation gave 0.7% of an essential oil with spicy odour resembling that of pepper and ginger oils and having the following characteristics—Sp. Gr.: 0.8484; Refractive Index: 1.4769; Optical Rotation: 40.1°.

Uses

The fruits are used as spice and also in pickles and preserves.

They have a pungent pepper-like taste and produce salivation and numbness of the mouth.

Alkaloid A present in long pepper showed significant *in vitro* anti-tubercular activity against *Mycobacterium tuberculosis* H-37 Rv strain; it inhibited the growth of the bacillus in 20 μg/ml concentrations.

Besides fruits, the roots and thicker parts of the stem are cut and dried and used as an important drug (Piplamul) in the Ayurvedic and Unani systems.

The fruits as well as the roots are credited with numerous medicinal uses, and may be used for diseases of respiratory tract, viz. cough, bronchitis, asthma, etc. as counter-irritant and analgesic when applied locally for muscular pains and inflammation; as snuff in coma and drowsiness and internally as carminative; as sedative in insomnia and epilepsy; as general tonic and haematinic; as cholagogue in obstruction of bile duct and gall bladder; as an emmenagogue and abortifacient; and for miscellaneous purposes as anthelmintic, and in dysentery and leprosy.

Alcoholic extracts of the dry fruits and aqueous extracts of the leaves showed activity against *Micrococcus phygenes* var *aureus and Escherichia coli*. Ether extract of the fruits showed larvicidal properties.

In Chhota Nagpur, the root is used to ferment rice beer. In Andaman Islands, the leaves are chewed like betel leaves.

PEPPERMINT

Bot. Name: *Mentha piperita* Linn.
Family: *Labiatae*
Hindi: *Gamathi Pudina, Paparāminta;* Punjabi: *Vilayati Pudina.*

Description and Distribution

M. Piperita is cultivated on an extensive scale in America,

Australia, England and in European countries. The plant was cultivated in the Nilgiris in 1818 and since then, it has been raised in Karnataka, Kashmir, Delhi, and also at the Forest Research Institute, Dehra Dun. Rooted suckers of this plant procured from the Agricultural College, Lyallpur, were propagated at Baramula 1675m, Srinagar 1525m and Yarikah 2135m. It is also grown in other Indian gardens.

Peppermint is a perennial glabrous, strongly scented herb grown or cultivated in temperate regions of Europe, Asia, etc. It is considerd to be a hybrid between *M. spicata* and *M. aquatica*. It is sensitive to drought conditions. It is erect, 30-90 cm high, purplish or green; leaves ovate or oblong, coarsely serrate, smooth and dark green above, pale or sparingly hairy below; flowers purplish, in thick terminal spikes.

India does not produce enough peppermint for the manufacture of peppermint-oil to meet her own requirements. Thus during 1981-82, out of the total imports of spice essential oils worth Rs 1.09 crores, the imports of peppermint oil alone amounted to Rs 86.11 lakhs i.e. about 80% of the total imports of spice essential oils. Thus, there is ample scope for extending the area under peppermint in the temperate and wet regions of the country.

The herb consists of the dried leaves or the crushed dried leaves of the cultivated peppermint plant.

Volatile Oil: The herb is the source of true peppermint oil, extensively used for flavouring and in pharmacy; it is official in many pharmacopoeias. Commercial oils are derived from cured, partially dried plants while official oils are obtained from fresh material; the oil is rectified, if necessary. The yield of oil varies from 0.3 to 1%, depending on the extent to which the material has been dried before distillation. Dried leaves and flowering tops from Kashmir gave 0.7-1.0% oil, while fresh mature leaves from Kanpur gave 0.32% oil.

Peppermint-oil is a colourless, pale yellow or greenish yellow liquid with a strong agreeable odour and a powerful aromatic taste, followed by a cooling sensation when air is drawn into the mouth. On ageing, the oil darkens in colour and becomes viscous. When chilled, menthol separates out as crystals. The oil contains menthol (50-55%), menthyl acetate, menthone

and small amounts of several other compounds. The peppermint oil, steam distilled from Kashmir grown plants, had the following physico-chemical properties—Specific Gravity at 15°C: 0.9187; Refractive Index: 1.4666; menthyl acetate: 14.4%; menthol:46.6%, and soluble in 6 volumes of 70% alcohol.

Peppermint oil is adulterated with dementholized Japanese mint oil, synthetic menthol, glycols, alcohol, benzyl alcohol, terpineol, eucalyptus oil and pennyroyal oil; it is sometimes contaminated with spearmint oil.

Uses

The herb is considered aromatic, stimulant, stomachic and carminative, and used for allaying nausea, flatulence and vomiting. Bruised leaves are employed as an external application for relieving local pains and headache. A hot infusion is taken to allay stomach ache and colicky diarrhoea. The drug is frequently adulterated with spearmint, which is difficult to detect.

Peppermint oil is one of the most popular and widely used essential oils. It is employed for flavouring pharmaceuticals, dental preparation, mouth washes, cough, drops, soaps, chewing gums, candies, confectionery, and alcoholic liquors. It is valued in medicine both for internal and external uses; for internal use, it is preferred to menthol because of its more pleasant taste. It is widely employed in flatulence, nausea and gastralgia. It may be administered with sugar or in the form of tablets and lozenges. The oil has mild antiseptic and local anaesthetic properties. It is used as an external application in rheumatism, neuralgia, congestive headache and toothache.

The green plant, left after the extraction of oil, may be dried into hay or silaged for use as cattle feed. The hay contains: protein, 12.7%; digestible protein 8.5%; and total digestible nutrients, 49.4%; and nutritive ratio, 4.8%. It may be employed as a substitute for lucerne hay for feeding dairy cows.

POPPY SEED

Bot. Name: *Papaver somniferum* Linn.
Family: *Papaveraceae*
Hindi and Bengali: *Kaskash;* Gujarati: *Khuskhush;* Kannada: *Khasksi;* Malayalam: *Kashakasha;* Marathi: *Khus Khus;* Punjabi: *Khush Khush*, *Khas Khas;* Sanskrit: *Khasa*, *Khakasa;* Tamil: *Gashagasha*, *Kasakasa;* Telugu: *Kasakasa*, *Gasagasla*, *Gasalu;* Urdu: *Kashkash sufaid*

Description and Distribution

Poppy is cultivated either for manufacture of opium or for seeds. In India, var. *album* of poppy with white seeds has been cultivated for many years for the production of seeds under license in Dehra Dun and Tehri Garhwal districts of UP and in Jullundur, Kapurthala, Hoshiarpur and Patiala districts of the Punjab. The continuance of cultivation of poppy for poppy-heads and seeds was reviewed by the All India Narcotics Conference 1956, and on their recommendation, Punjab Government banned the cultivation of opium poppy for poppy heads, with effect from March 1958. The UP Government was, however, allowed to continue cultivation of poppy for poppy-heads for a maximum period of four years by which time it was expected that necessary development measures would be taken to enable the cultivation to raise alternative crops in lieu of opium poppy. In India, best seeds are obtained when the capsules have not been incised for extraction of opium. The crop is reported to yield 220-275 kg of seeds per hectare (200-250 lb./acre). In Europe, var. *nigrum* which has slate to blue coloured seeds, and known as 'Maw Seeds,' is exclusively cultivated for this purpose.

Composition

The white seeds are very small. 1000 seeds weigh only 0.25 to 0.5g! The analysis of seeds from five types of Indian poppy gave the following ranges of values—moisture: 4.3-5.2%; protein: 22.3-24.4%; ether extr.: 46.5-49-1%; N-free extr.:

11.7-14.3%; crude fibre: 4.8-5.8%; ash: 5.6-6.0%; calcium: 1.03-1.45%; phosphorus: 0.79-0.89%; iron: 8.5-11.1mg/100g; thiamine: 740-1181; riboflavin: 756-1203; and nicotinic acid 800-1280 μg/100 g: carotene is absent. Minor minerals in the seeds include iodine (6μg/kg); manganese (29mg/kg); copper (22.9mg/kg); magnesium (15.6g/kg) and zinc (130mg/kg). The seeds also contain lecithin (2.80%), oxalic acid (1.62%), pentosans (3.0-3.6%), traces of narcotine and an amorphous alkaloid, and the enzymes diastase, emulsin, lipase and nuclease.

The seeds have a high protein content, the major component being a globulin which accounts for 55% of the total nitrogen. The amino acid make-up of the globulin is similar to that of the whole seed protein and is as follows (g/16g N); arginine: 10.4; histidine: 2.9; lysine: 1.5; tyrosine: 4.7; tryptophan: 2.0; phenylalanine: 4.1; cystine: 2.0; methionine: 2.3; threonine: 4.2 and valine: 7.1. The proteins are deficient in lysine and methionine. At 10% level of intake, they have a biological value of 57.9% and a digestibility co-efficient of 81%.

Poppy Seed Oil: Poppy seeds contain upto 50% of an edible oil which is extracted by either cold or hot expression. The oil is odourless and possesses a pleasant almond-like taste. In India, the oil is generally extracted by cold-pressing the seed in small presses in homes or small establishments (oil yield about 20%). Raw cold-pressed oil is pale to golden yellow in colour.

Poppy seed oil has the following ranges of constants—Sp. gr. 25°/25°: 0.924-0.927: Refractive Index: 1.467-1.470; Iodine value: 132-142; Sap. value: 188-196; Acid value 3-13%.

Uses

The poppy seeds are utilized as food and as a source of fatty oil. They are considered nutritive and are used in breads, curries, sweets and confectionery. Seeds are demulcent and are used in the form of emulsion as an emollient and as specific against obstinate constipation and in catarrh of the bladder. The white seeds are sometimes used in pharmaceuticals. Poppy seeds or seed meal also find use in the production of lecithin (yield, 0.67-0.91%).

Poppy Seed Oil is edible without refining; it does not develop rancidity easily. Hot-pressed oil is largely used in soap making. It may be rendered edible by refining. The oil yield from black and white seed is about the same, but the former is more commonly used for expression of the oil because of its easier cultivation. However, white seeds are reported to yield the finest oil. Seeds from the capsules which have not been scarified for opium, give a higher yield of oil than from those scarified.

Poppy seed oil is widely used for culinary purposes. It is free from narcotic properties and is used mixed with olive oil, or as a salad oil. It has a high digestibility co-efficient of about 96% at a daily intake of 50g. On hydrogenation, it yields a product similar to hydrogenated groundnut oil which may also be useful for industrial purposes.

It is a non-yellowing drying oil forming a hard and lustrous film. The oil is rendered colourless by exposure to the sun. It dries much slower and more uniformly than linseed oil. Modified oils, with good drying properties for use in paints or varnishes, can be prepared by heating the raw oil for 5-12 hours at 150-180°, in the presence of catalysts. Blown poppy seed oil on dehvdration and treatment with cobalt, forms films resistant to boiling water and, in this respect, equivalent to those formed by dehydrated castor oil.

Poppy seed oil is used in the production of artists' paints; for this purpose, sun-bleached oil from the first cold pressings of the seed is preferred.

The oil is useful in the preparation of linoleic acid, soft soaps, ointments and emulsions, and compositions for skin care. The oil finds use also as an illuminant.

It is used against diarrhoea, dysentery and scalds. Lower grades are used for lubrication. Poppy seed oil is used in Europe as a substitute and adulterant of olive oil which it resembles very much.

Poppy Seed Cake: The cake or the meal left after extraction of the oil from the seeds, is sweet and nutritious and is eaten by poor people. It is readily consumed by cattle and sheep, and may be fed alone or preferably mixed with other feeds. However, excessive feeding of the cake (over 1 kg/day) to dairy cattle may result in decrease of the content of milk

and in soft fat. The cake is not recommended for young oı breeding animals.

Analysis of the cake gave the following values: moisture: 10.8%; crude protein: 36.6%: N-free extr.: 20.7%; ether extr.- 11.6%; mineral matter- 12.4%; dig. protein- 30.4%; and total dig. nutrients; 62.3%; nutritive ratio: 1. The cake may also be used as a manure.

The seed cake may sometimes prove toxic to cattle owing to the presence of alkaloids arising from contamination of the seed with particles of the capsule. This results in marked gastroenteritis, nervous excitement, lack of appetite and colickly pains. Lactation may cease and cattle lose weight progressively; a few fatal cases have also been reported.

Capsules: The capsules contain the same constituents as opium but in much smaller quantites. The total alkaloid content of the unlanced capsules from Indian sources was found to be 0.4-0.6% and that of the lanced capsules 0.15-0.22%. The concentration of morphine in the capsules shows large variations; the value ranged from 0.18 to 0.90% in samples of capsules from several countries. The capsules account for about 70% of the total morphine of the plant. The morphine in the capsules decreases rapidly on storage. Narcotine content of the capsules in reported to be 0.1-0.2%.

An infusion of the capsules is used as a soothing application for bruises, inflammatory swellings and sometimes for painful conjunctivitis and inflammation of the ear. A hot decoction of capsules is applied as an anodyne. Capsules are used also in the form of syrup or extract as a sedative against irritant coughing and sleeplessness. In India, an intoxicating liquor is prepared by heating the capsules with jaggery and water. In the USA, mature poppy capsules have been processed to yield a liquor which can be used as a substitute for opium in the production of morphine. In Europe, instances of poisoning have been reported when cattle have eaten unripe capsules of the plant.

Poppy straw: (dry, unlanced empty capsules having a stem of about 7.5 cm) has been made use of in Europe and other places where the plant is cultivated primarily for its seed and oil, as a source of morphine and narcotine. The two alkaloids

are obtained in a yield of 0.08 and 0.009% respectively. Poppy straw and heads have also been processed to yield concentrated alkaloidal extracts, such as 'Optopon' (morphine: 20-22% alkaloids: 16-18%) which can be used directly as a pharmaceutical. Poppy straw has also been tried for the manufacture of hand-made boards.

Young poppy plant is sometimes eaten like lettuce. It is grown as a pot-herb in Iran and is also fed to cattle. Leaves and petals have been used for packing opium. Leaves are also smeared as anodyne. Leaves also contain 0.3 to 0.2% of morphine.

The poppy plant has been tried in the production of paper pulp. Kraft pulping gave pulps having good strength properties and useful for the manufacture of wrapping papers, bags and other grades requiring an improved formation.

The red poppy flowers are used in medicine for making a syrup. The red and lilac flowers contain a colouring matter and are suitable for use as an indicator.

ROSEMARY

Bot. Name: *Rosmarinus officinalis* Linn.
Family: *Labiatae*
Hindi: *Rusmary*

Description and Distribution

Rosemary of commerce comprises dried leaves derived from an exotic, leafy, evergreen shrub of *R. officinalis*, upto 2 metres high, cultivated in Indian gardens in cool places for its pleasantly fragrant leaves. The leaves are narrow, about 2.5 cm long, and resemble curved pine needles. It bears a few bluish, white or violet flowers.

Rosemary grows and is cultivated in Yugoslavia, Spain, Portugal, and other parts of Europe as well as in the USA.

Rosemary is a native of southern Europe and grows wild on dry rocky hills in the Mediterranean region. It has been suggested as suitable for cultivation in the temperate Himalayas and Nilgiri hills with dry to moderately moist climate.

The colour of the dried herb is brownish green. Rosemary leaves have a tea-like fragrance. The crushed rosemary, however, has an agreeable and fragrant, spicy aroma with a camphoraceous note. The taste has fragrant, spicy, pungent, bitter and camphoraceous notes.

Composition: Dried rosemary leaves have the following typical composition—moisture: 5.7%; protein: 4.5%; fat: 17.4%; crude fibre: 19%; carbohydrates: 47.4%; ash: 6.0%; calcium: 1.5%; phosphorus: 0.70%; iron: 0.03%; sodium: 0.04%; potassium: 1.0%; vit. A: 175 I.U./100g; vit. B_1: 0.51 mg/100g; vit. B_2: 0.04%; niacin: 1.0%; vit. C: 61.3 mg/100g. Calorific Value: 440 calories/100g.

The dried rosemary leaves, on steam distillation, yield 1-2% of a volatile oil (Oil of Rosemary) used in perfumery and medicine. In addition, leaves contain a saponin, tannin, ursolic acid, carnosic acid, amyrins, betulin and rosemarinic acid. A phenolic fraction possessing anti-oxidant properties has been isolated from the leaves and also from the oil.

Volatile Oil: This is obtained by steam distillation of the leaves, flowering tops and twigs. The bulk of the commercial oil comes from plants growing wild in Spain, with smaller quantities from France, Dalmatian Islands, Tunisia and Morocco. Indian requirements are met with only by import. The characteristics of the oil vary with the source and also with the parts of the plant distilled, the finest product being obtained from the dried leaves freed of stalks. The oil is a pale yellow or almost colourless liquid with the characteristic odour of the leaves and a warm camphoraceous taste. It has the following properties—Sp. gr. at 15°C: 0.895-0.920; Optical Rotation at 20°C:—2 to +15°; Refr. Index at 25°C: 1.466-1.472; Solubility: 1 part in 10 parts of 80% alcohol. The chief constituents of the oil are pinene, camphene, cineol, camphor borneol and bornyl acetate.

Adulteration: The oil is sometimes adulterated with eucalyptus, sage, spike and turpentine oils, and their fractions.

Uses

Fresh tender tops are used for garnishing and for flavouring cold drinks, pickles, soups, and other foods. The leaves are employed as a condiment; dried and powdered, they are added to cooked meats, fish, poultry, soups, stews, sauces, dressings, preserves and jams. They are mixed with sage in pork and veal stuffings, and sometimes are added to biscuits.

Oil of Rosemary is used mainly in cheap perfumery, scenting, of soaps and hair lotions, and denaturing of alcohol. It is also employed in room sprays and inhalants. Superior grades of the oil are employed for blending in eau-de-cologne and for flavouring of meats, sausages, soups, table sauces and other food products.

The oil also finds use in medicinal preparations and as an ingredient in rubefacient liniments. It is official in some of the pharmacopoeias. It is mildly irritant and has been used as a carminative. Internally, the oil may be taken as a stimulant in doses of a few drops; a 5% tincture is used as a circulatory and cardiac stimulant. The oil is useful in headache and in tardy menstruation. It is diaphoretic and is employed with hot water in chills and colds. An emulsion prepared from the oil is used as a gargle for sore-throat. The oil exhibits anti-bacterial and protistocidal activity.

All parts of the plant are astringent and serve as a nervine tonic and an excellent stomachic. An infusion of the plant with borax is employed as a hair wash and is said to prevent premature baldness. The plant has been found useful in atonic dyspepsia. Tea made of rosemary is used in Central America to cause temporary sterility.

Flowering tops and leaves have a camphor-like odour and taste and are considered carminative, diaphoretic, diuretic, aperient, emmenagogue, stimulant and stomachic. They are used for vapour baths for the relief of rheumatism, paralysis and incipient catarrhs. Dried leaves are smoked for the relief of asthma. A decoction of leaves is employed as an abortifacient. Pressed juice of the leaves possesses a strong anti-bacterial action on *Staphylococcus aureus*, *Escherichia coli* and *Bacillus subtilis*.

Flowers are an excellent source of honey and they impart their characteristic flavour to the honey.

SAFFRON

Bot. Name: *Crocus sativus* Linn.
Family: *Iridaceae*
Hindi: *Zaffran, Kesar;* Bengali: *Jafran;* Gujarati: *Keshar;* Kannada: *Kunkuma Kesari;* Kashmiri: *Kong;* Marathi: *Keshar, Kesara;* Punjabi: *Kesar, Zafran;* Sanskrit: *Keshara, Kunkuma, Aruna, Asra, Asrika;* Tamil: *Kungumapu;* Telugu: *Kunkumapuva;* Urdu: *Zafran, Jafranekar.*

Description and Distribution

Saffron consists of the dried stigmas of *Crocus sativus* which is a bulbous perennial, 15-25 cm high, native of Southern Europe and cultivated in Mediterranean countries, particularly in Spain, Austria, France, Greece, England, Turkey, Persia, India, and the Orient. True saffron must not be confused with either *meadow saffron (Colchicum autumnale* L. fam. Liliaceae) or safflower, or *bastard saffron* (*Carthamus tinctorius* L., fam. Compositae), which are occasionally used as adulterants of true saffron. Saffron is one of the oldest and certainly among the world's most expensive spices. One pound of saffron consists of about 225,000 to 500,000 dried stigmas, and requires the picking (by hand) of 75,000 flowers. That gives an idea of the human labour involved in harvesting saffron. The colour of saffron is bright yellow-red, the aroma powerful, somewhat bitter, peculiar and exotic.

Saffron is a low growing plant with an underground globular corm. It is cultivated for its large, scented, blue or lavender flowers. The flowers have trifid, orange-coloured stigmas which along with the style-tops yield the saffron of commerce.

The valley of Kashmir is famous for its saffron fields (total

area, 3350 acres) located on both sides of the national highway on the Karewas (elevated dry table lands of alluvial origins) of Pampore (alt. 1700m) about 18km south-east of Srinagar. Some saffron is grown also in the Kishtwar region of Jammu.

In 1961-62, India imported 14kg of saffron from Spain, France and other sources where it is grown as a regular irrigated crop. Figures for later years are not available. The price of saffron is quite high, i.e. more than Rs 6,000 per kg. Hence, it is necessary to extend its cultivation in hilly areas.

Picking of Flowers for Obtaining Saffron: The flowering period starts during middle or late October and lasts only until the first or second week of November. The flowers must be picked each morning before the sun gets too hot. The flowers are cleaned during the day and the style and stigmas are separated from the perianth. These operations require much labour which, coupled with the small yield per acre, accounts for the very high cost of good quality saffron. The duration of picking depends upon the time of blooming. The number of flowers and time of blooming in any year are dependent upon the temperature prevalent in spring and autumn, and upon the amount of rainfall. A warm spring and long autumn are conducive to early flowering.

Separation of stigmas from the perianth has to be carried out every day, otherwise the flowers wilt. If the flowers are left for a couple of days, operations become very difficult. The collected flowers are picked up individually. The female worker employed for this job holds a flower in her hand and with the thumb-nail of the same hand, she removes the pistils below the perianth, at the same time tearing off the stigmas with the fingers of the right hand and depositing these in the containers held for this purpose.

Drying or Toasting of the Stigmas to Obtain Saffron: The value of saffron depends mainly on the method by which and stigmas are dried. The techniques followed in Kashmir and Spain are described below.

In Kashmir, the stigmas picked from the flowers and dried, are arranged and constitute the first grade *(Shahi Saffron)*. The flowers are dried in the sun three to five days, then lightly

beaten with sticks and passed through coarse sieves. The material which passes through is thrown into water, those parts of the flowers which float are discarded and the parts which sink to the bottom are collected and further dried, constituting the second grade (*Mogra Saffron*). The discarded parts of the flowers are again subjected to the beating process and the process of throwing the entire pounded mass in water is repeated. The product which sinks is collected, and is very much inferior in value, constituting the 3rd Grade (*Lachha Saffron*).

In Spain, where the process is called 'toasting,' the stigmas are placed in sieves, in layers 2 to 3cm thick over an almost spent fire. The sieves are placed 15cm above the fire and by stacking them and changing their order and position, the product is carefully dried. In addition, the process may utilize special stoves for the purpose that the saffron has to be kept protected from dampness and light because light bleaches it into dull yellow.

The yields of saffron, both in Kashmir and Jammu, are much lower than those in other countries, where yields are 8-11 lbs per acre. About 5 lbs of fresh stigmas yield 1 lb of saffron.

The final product as sold in the bazaar is a loosely matted mass of dark, reddish brown flattened stigmas with a characteristic aromatic odour and bitter taste. When fresh, they are glossy and unctuous (soapy or greasy) to the touch, but after keeping, they become dull and brittle.

Composition

The average composition of commercial saffron is as follows—water: 15.6%; starch and sugars: 13.35%; essential oil: 0.6%; fixed oil: 5.63%; total N-free extract: 43.64%; crude fibre: 4.48%; and ash: 4.27%. Yields of essential oil and fixed oil as high as 1.37% and 13.4% respectively, have been recorded. The ash is rich in potassium and phosphorus and contains traces of boron. Kashmir saffron contains 8.5-10.2% moisture and 5.9-13.3% total ash.

Adulteration: Because of its high cost, saffron is frequently adulterated with styles, anthers and parts of corolla of saffron.

Exhausted saffron, flowers and floral parts of some Compositae like *Calendula spp.* and *Certhamus inctorius*, corn silk, and various materials coloured with coal tar dyes, are also used as adulterants. Water, oil or glycerine is added to increase the weight. Cake saffron of commerce often contains safflower florets with adhesive sugary substances.

Uses

Saffron is famous for its extraordinary medicinal, flavouring and colouring properties. It is used abroad in exotic dishes particularly in Spanish rice specialities and French fish preparations. It is also used in fine bread in many countries, in Scandinavia as well as in the Balkans.

The principal colouring agent of saffron is the glycoside crocin; the bitter substance is the glucoside picrocrocin.

Medicinal Properties: Saffron is credited with various medicinal properties. It is used occasionally in exan-thematous diseases to promote eruptions. It is used in fevers, melancholia and enlargement of the liver and spleen. It has also stimulant and stomachic properties and is considered to be a remedy for catarrhal affections of children. In modern pharmacopoeias, it is employed only to colour other medicines or as a cordial adjunct. Saffron has been employed as an abortifacient and several fatal cases have been recorded. Saffron bulbs are toxic to young animals, and stigmas in overdoses are narcotic.

Saffron is an important ingredient of the Ayurvedic and Unani systems of medicine in India. It is popularly known as a stimulant, warm and dry in action, helping in urinary, digestive and uterine troubles. It is mixed with other drugs to help in normal menstruation. If soaked overnight in water and used with honey, it enables the patient suffering from urine troubles to pass urine freely.

Its oil is used as an external application in uterine sores. When pounded with ghee, it is reported to be very effective in diabetes. It is also reported to give strength to the heart and brain, but only when administered in large doses.

SAGE

Bot. Name: *Salvia officinalis* Linn.
Family: *Labiatae*
Hindi: *Salvia, Sefakuss.*

Description and Distribution

Sage is the dried leaf of *Salvia officinalis* which is a member of the mint family. It grows and is cultivated in Yugoslavia, Portugal, Spain, Cyprus, England, Canada and the United States.

It is a hardy, variable sub-shrub, native of southern Europe, often cultivated as a spice and for medicinal purposes. It is also grown for ornament. Stems shrubby, white-woolly, 15-30 cm tall; leaves aromatic, petiolate, oblong; flowers blue, purple or white in simple racemes. The cultivation of garden sage has been tried in Jammu for its essential oil which is now being imported for use in soap and perfumery industry. The plants are reported to have done well, the quality of the oil obtained being comparable with oils of foregin origin.

Young plants which have not reached the flowering or seeding stage, possess the finest aroma and contain the largest amount of oil. Harvesting is done by hand or by cutting the tops with a mower. Sometimes whole plants are cut by small sickles and dried. Sage is dried in the shade to retain as much of the natural colour and flavour as possible. The leaves and small tops are tied into small bundles or spread on screens and dried in a well-ventilated warm room away from direct sunlight. If the leaves are dusty or gritty, they are washed in cold water before drying. The dried bunches can be sold without further treatment or the leaves may be pulverized for the packeted herb trade.

Sage growing wild in the Dalmatian region of Yugoslavia is considered by the trade to be the best in quality, and the product derived from cultivated plants in this region is rated next in preference. The odour is strong, fragrant and aromatic, and the taste aromatic, warm, somewhat astringent and a little

bitter. Other products such as Spanish sage and Greek sage derived from other species of Salvia are used either as substitutes or adulterants of the genuine product.

Composition

Moisture: 5.7%; protein: 10.2%; fat: 14.1%; crude fibre: 16.0%; carbohydrates: 46.3%; total ash: 7.7%; calcium: 1.8%; phosphorus: 0.09%; iron: 0.03%; sodium: 0.01%; potassium: 1.0%; vit. A: 2395 I.U./100g; vit. B_1: 0.75 mg/100g; vit. B_2: 0.34; vit. C: 39.8; niacin: 5.7 mg/100g. Calorific Value: 415 calories/100g.

Volatile Oil: On steam distillation, dry sage leaves yield an essential oil, 1.3-2.6% on the weight of dry leaves. The oil is produced commercially in Yugoslavia, Spain, Corfu, Syria, and the USSR, and samples from different sources show considerable variation in properties and constituents. Analysis of an oil sample obtained by hydrodistillation of the dried herb (yield 1.1%) from Kashmir gave the following values—Specific gravity; 0.9268; Refractive Index: 1.4633; Optical Rotation: 0.2°; Acid val.: 1.1; and ester val. after acetylation: 30.0. The constituents reported to be present are α-pipene (1.8%), cineole, linalyl acetate (10.1%); thujone (44.45%); borneol, bornyl acetate, farnesol and camphor. Linalyl acetate content of the oil is too low for the commercial exploitation of the oil for the ester. The quality of sage oil is determined on the basis of its thujone content; the higher the thujone content the better the oil.

In addition to the essential oil, leaves contain tannin 3%, fumaric, malic, and ursolic acids, a bitter principle, picrosalvin, saponin, pentoses, a wax and potassium nitrate.

Uses

As Food Flavourant: Sage is the most popular herb for use in culinary preparations in the West. It is used in pork sausage and baked loaf. The colour of the dried herb is grey, tinged with green; the aroma is strong, fragrant, and spicy. The taste is fragrant, spicy, warm, astringent, and a little bitter. Sage is the most important herb in every kitchen for flavouring meat and fish dishes and in making poultry stuffings. It

is used in poultry dressing sausage, liver sausage and hamburger seasoning.

Sage has been extensively employed in the food industry as a standard spice in making stuffing for fowl, meats and sausage. It is one of the most important culinary herbs. Dried and powdered leaves are mixed with cooked vegetables and sprinked on cheese dishes, cooked meats and other similar preparations. Fresh sage leaves are used in salads and sandwiches. The young leaves are pickled, and used for making tea. The apples or tumours on the sage caused as a result of puncturing by a species of Cynips are made into a conserve with honey.

Medicinal Uses: Sage is used as a mild tonic, astringent, and carminative. An infusion of the leaves is used as a gargle in the treatment of sore-throats; hot infusion is said to be diaphoretic. Extracts of sage leaves are also reported to be antipyretic. A strong infusion of the herb is used to dry up the breast milk for weaning children. Sage has been prescribed to cure female disorders since ancient times and estrogenic substances are said to have been extracted from the dried leafy tops. Dried leaves are used as a fumitory. Leaves rubbed on teeth function as a good dentifrice. The herb has been used in tooth and mouth washes, gargles, poultices, tooth powders, hair tonics and hair dressings.

Use in Perfumery: Sage oil finds use in perfumes as a deodarant, in insecticidal preparations, for the treatment of thrush and gingivitis, and as carminative. The oil is used as a convulsant, and it resembles wormwood oil in action but is less active.

Sage oil is used for adulterating rosemary and lavender oils. Sage oil itself is adulterated with American cedar leaf oil which also contains thujone.

Use as Anti-oxidant: Sage and sage oil exhibit anti-oxidant properties. Five anti-oxidant fractions with anti-oxidant indices between 8.8 and 10.0 have been isolated from the leaves of *S. officinalis*, one of which appears to be polyhydric phenol.

Use of Residue: After steam distillation, the residual plant material still contains constituents of considerable flavour value. Hot water extracts of the material on concentration

yield an oleoresin, which is used conjunction with the oil for flavouring foods.

Use of Seeds: Seeds contain 18% of protein and yield a drying oil which is used as a bonding agent in the production of oil paints.

SAVORY

Bot. Name: *Satureia hortensis* Linn.
Family: *Labiatae*

Description and Distribution

The dried leaves and flowering tops derived from *S. hortensis* constitute the savory of commerce. The best quality savory comprises of dried leaves only. *S. montana*, constitutes 'summer savory.'

Savory is an erect pubescent annual herb 25-35 cm high with pinkish branches, found in Kashmir. Leaves oblong-linear or lanceolate with deep pitted glands on both sides; flowers in small auxilary cymes. It grows in southern France, Germany, Spain and other parts of Europe; also in England, Canada and the USA. The dried leaves are of brown-green colour, and upto 10 mm in length. The odour is strong, warm and highly aromatic, the taste somewhat sharp and camphoraceous. It is marketed both in whole and ground form.

Composition

Moisture: 9.1%; protein: 7.1%; fat: 5.2%; crude fibre: 15.3%; carbohydrates: 54.6%; total ash: 8.7%; calcium: 2.2%; phosphorus: 0.14%; iron: 0.04%; sodium: 0.02%; potassium: 1.1%; vit. A: 865 I.U /100g; vit. B_1: 0.37%mg/100g; vit. B_2: 0.04; vit. C: 12.0; niacin: 4.1 mg/100g. Calorific Value: 355 calories/ 100g.

Analysis of the green herb (leaves and flowering tops) collected at the end of the blooming period showed—moisture: 71 88%; protein: 4.15%; fat: 1.65%; sugar: 2.45%; fibre: 8.6%; and ash: 2.11%. The dry matter contains 11.95% pentosans.

Volatile Oil: Savory contains 1% volatile oil, chief constituent of which is carvacrol—a colourless to pale-yellow liquid with a pungent, thymol odour. Its physico—chemical properties are—Specific gravity at 15°C: 0.896-0.960; Optical Rotation: -0°56' +0°4'; Phenols: 30 to 42 per cent; and soluble in 2 volumes of 80% alcohol.

Uses

Savory is used in flavouring of soups and sauces, egg, salad dishes, and poultry dressing. It is used in pork sausage and vegetables take on a new flavour when the tiny leaves of summer savory are used instead of parsley or chives.

The herb is reported to be carminative and stimulating. The anti-oxidant property of the herb is reported to be due partly to labiatic acid.

SHALLOT

Bot. Name: *Allium ascalonicum* Linn.
Family: *Liliaceae*
Hindi: *Ek-kanda-lasun, Gandana;* Bengali: *Gundhun*; Punjabi; *Gandana, Gandhan.*

Description and Distribution

Shallot belongs to the onion and garlic family and is similar in properties to that of garlic. The shallot is a native of Palestine and is cultivated in the USA and some European countries, and in Indian gardens for its bulbs and green leaves. Clusters of greenish white or red cloves occur at the base of its hollow cylindrical leaves. A variety of shallot, smaller and

with a larger number of cloves is exported to Sri Lanka and Malaysia from Madras.

The plant is a perennial that seldom produces seeds and therefore must be increased by division of its compound bulbs, which are made up of several bulbets or cloves held together at the base. The bulbs are not encased by a sheath as in garlic. The bulblets are planted in the same manner and at the same season as are onion sets, each set developing into a compound bulb. The mature bulbs are harvested, cured and stored in the same manner as onions. In suitable storage, the bulbs keep from one season to the next.

Composition

No published information available.

Uses

The flavour of shallots is somewhat milder than that of onions. The chief use is for flavouring curries, both leaves and cloves being used. Most of the crop is produced for sale in the green state, but some dry bulbs are also used. They are also used for pickling.

It is used to cure ear-ache, a small piece being placed in the meatus. It is also fried in butter and preserved in honey as an aphrodisiac.

In Ghana, the bulbs are ground and rubbed on the skins of feverish children. This is said to cure them.

Sometimes, they are mixed with palm vine and large pepper and heated in the sun, the mixture being used to cure fever. They are also used as antidote for snake bite and poisoning.

SPEARMINT

Bot. Name: *Mentha spicata* Linn.
Syn: Mentha viridis Linn.
Family: *Labiatae*
Hindi: *Pahari Pudina;* Bengali: *Pudina;* Gujarati: *Phudino;* Punjabi: *Pahari Pudina Pudinakuhi;* Sindhi: *Phudina*; Telugu: *Pudina.*

Description and Distribution

Spearmint belongs to the Mint Family and is a relative of mint and peppermint described earlier. It is in great demand as judged from the imports of spearmint oil during 1971-72, totalling to 7,651 kg valued at Rs 6,70,755. The area under spearmint, therefore, needs to be extended. It is the fresh and dried leaves which are used as a spice.

It is a glabrous perennial, 30-90 cm high, with creeping rhizomes, indigenous to the north of England, but grown all over the world. It is cultivated in Indian gardens in the plains. Leaves smooth or nearly so, sessile, lanceolate to ovate, acute coarsely dentate, smooth above, glandular below; flowers lilac, in loose, cylindrical, slender, interrupted spikes. The leaves have a characteristic, aromatic odour and slightly pungent taste, *not* followed by a cooling sensation as in the case of peppermint.

Composition

Analysis of fresh spearmint leaves gave the following values—moisture: 83.0%; protein: 4.8%; fat: 0.6%; carbohydrates: 8.0%; fibre: 2.0% and mineral matter: 1.6%; calcium: 200 mg. phosphorus: 80 mg; iron: 15.6% mg; carotene (as vitamine A): 2,700 I.U.: nicotinic acid: 0.4 mg; riboflavin: 80 μg; and thiamine: 50 μg/100g; the leaves contain traces of copper (1.8 μg/g).

Volatile Oil: The fresh flowering herb on steam distillation yields 0.25-0.50% of a volatile oil, known as Spearmint oil. It is a colourless, yellow or greenish yellow liquid with the

characteristic odour and taste of spearmint; the aroma improves on ageing. The characteristics of spearmint oils obtained on an experimental scale at different places in India are as follows:

The characteristic constituent of the oil is l-carvone. Oil distilled at Kanpur contained carvone. 55.8%; terpenes (chiefly l-limonene and dipentene): 17.5%; alcohol (as dihydrocarveol): 6.7%; and esters (as dihydrocarveol acetate): 11.6%. A sample of oil distilled from plants grown in Pune contained no carvone. These differences in composition of spearmint oil are evidently due to varietal or specific variations. Specific gravity: 0.925-0.940; Optical Rotation:—30° to 60°; Refractive Index: 1.4800-1.4900; and carvone content: 42-60%.

Uses

Green leaves of the plant are used for making chutney and for flavouring culinary preparations, vinegar, jellies and iced drinks.

The herb is considered stimulant, carminative and antispasmodic. A smoothing tea is brewed from the leaves and an alcoholic beverage (*mint julep*) is prepared from them and used as an antidote for poison. A sweetened infusion of the herb is given as a remedy for infantile troubles, vomiting in pregnancy and hysteria. The leaves are used in fevers and bronchitis.

Spearmint oil is used for flavouring chewing gums, tooth pastes, confectionery and pharmaceutical preparations.

STAR-ANISE

Bot. Name: *Illicium verum* Hook.
Family: *Magnoliaceae*
Hindi: *Anasphal;* Marathi: *Badian;* Tamil: *Anashuppu, Anasipu;* Telugu: *Anaspuvu.*

Description and Distribution

Star-Anise is the dried, star-shaped fruit derived from *Illicium verum* which is an evergreen tree attaining a height of 8-15 m and a diameter of about 25 cm. Leaves entire, 10-15 cm long and 2.5-5 cm broad, elliptic to oblanceolate; flowers solitary, white to red in colour; fruit star-shaped, reddish brown, consisting of 8 carpels (follicles) arranged in a whorl around a short central column; each follicle 12-17 mm long, boat-shaped, hard and wrinkled, containing a seed; seeds brown, compressed-ovoid, smooth, shiny, brittle. The carpels have a pleasant anise-like odour and aromatic, sweet, anise-like taste; the seeds have the same to a much lesser extent. It is available whole, and is not usually ground. The plant is indigenous to tropical and subtropical east Asia. It is extensively cultivated in a limited area with particular ecological factors, in Kwangsi in south-east China and Tonkin in Indo-China. It does not occur in India, but is mostly imported from China and Indo-China. No import statistics are, however, available for star-anise.

Adulteration: Star-anise fruit is often adulterated with the fruit of *I. anisatum* Linn. syn, *I. religiosum* Sieb & Zucc., grown in Japan and variously known as 'Japanese sacred anise tree,' 'Poison bay,' 'Shikimi' or 'Shikiminoki,' 'false aniseed' and 'bastard star anise.' The fruit of *I. anisatum* is poisonous.

Volatile Oil: Star-anise oil of commerce is obtained by the steam-distillation of fresh fruits of *I. verum* (yield 3-3.5%). It is colourless or pale yellow with the characteristic odour and aromatic taste of true anise oil (from *Pimpinella anisum*): the odour and taste of the latter are rather more delicate. The oil has the following characteristics—Specific gravity 25°; 0.978-0.987; Refractive Index at 20°C; 1.5530-1.5582; Optical Rotation;— 1.77° to 0.57°; congeal. pt.; 15.0-18.4°; sol. in 1.0-2.5 vol. of 90% alcohol; anethole is the chief constituent (85-90%). Star anise oil is official in the pharmacopoeas of many countries; it constitutes the bulk of the oil of anise of commerce.

Fatty Oil: Decorticated seeds contain a fatty oil (55%) having the following constants—Specific Gravity at 25°; 0.9128:

Refractive Index at 25°C; 1.4677; sap. val; 194.5; iod val.; 88.36; acid val.: 11.65; acetyl val.: 8.37; R.M. val.; 0.75; Polenske val : 0.29 and unsapon matter: 0 59%. The component fatty acids of the oil are; myristic: 4.43; stearic: 7.93: oleic: 63.24; and linoleic: 24.4%.

Uses

Star-anise fruit has an agreeable, aromatic, sweet taste and a pleasant odour resembling anise. It is used as a condiment for flavouring curries, confectioneries and spirits, and for pickling. It is also used in perfumery. The fruit is chewed to sweeten the breath and to help digestion.

It is stomachic and carminative, and considered useful in flatulence, spasmodic affection of the intestinal canal, and dysentery. It is used as an adjunct to cough mixtures and as a corrective of taste. It is also used in the production of absinthel (spirit).

Star-anise oil is used as flavouring agent in confectionery, candy, chewing gum, tobacco, animal feeds, liquors and pharmaceutical preparations. It is also used in perfumery and soaps.

The oil is stimulant, stomachic, carminative, mildly expectorant and diuretic. It relieves colic and is an ingredient of cough lozenges. The oil is employed as an application in rheumatism and otalgia, and as an antiseptic. It is considered useful against body lice and bed bugs, and forms an ingredient of cattle sprays. It is used in favus (honeycomb ringworm) and scabies. The oil enters into the composition of a number of official preparations.

Star-anise plant is used for flavouring foods and confectionery and is considered useful for colic, constipation and insomnia. The Chinese are reported to prepare a medicinal tea from the leaves, and also claim that one or two carpels of star anise when added to chicken which is to be roasted, improves its flavour tremendously.

SWEET FLAG OR CALAMUS

Bot. Name: *Acorus calamus* Linn.
Family: *Araceae*
Hindi: *Bach Gorabach;* Assamese: *Themeprii;* Bengali: *Bach;* Gujarati: *Gandhilovaj, Godavaj;* Kannada: *Baje, Bajegida;* Kashmiri: *Vabi*; Malayalam: *Vashampe;* Marathi: *Vekhand, Bariboj, Wach;* Punjabi: *Bacha;* Sanskrit: *Bhadra, Gulami;* Tamil: *Vashambu;* Telugu: *Vadaja Vasa;* Urdu: *Bacha.*

Description and Distribution

Sweet Flag or Calamus is reported to be common in Kashmir and Kumaon range of the Himalayan forests. The rhizomes are collected from the Himalayan forests and brought to Kathgodam from where they are despatched to Bombay, Calcutta and Kanauj, etc.

It is a semi-aquatic perennial herb with a creeping and much branched aromatic rhizome. The rhizome is cylindrical or slightly compressed, about 19-25 mm in diameter and about 10 cm long. Externally, it is light brown or pinkish-brown, and is white and spongy within. It is thoroughly washed with water, freed from dirt, and rootlets are removed and then carefully dried at low temperature. It deteriorates with age and is subject to attack of worms. It is this dried rhizome which constitutes the calamus or sweet flag used as condiment and in medicine. It is found wild or cultivated throughout India and Sri Lanka, ascending to 1830 metres in the Himalayas. The plant thrives in marshy places and a moist situation, like the edges of lakes and banks of streams. It is plentiful in the marshy tracts of Kashmir and Sirmoor, in Manipur and the Naga hills. It is cultivated in Karnataka and also in Europe and the USA.

Volatile Oil: The dry rhizomes on steam distillation, yield 1.5-3.5% of a yellow aromatic volatile oil. It has a mellow odour resembling that of patchouli. Prior to charging the steam distillation still, the rhizomes are reduced to the desired size in a suitable disintegrator. The yield is about 4.6%.

Indian calamus oil has the following properties—Specific Gravity at 15°C: 0.958-0.970; Refractive Index at 30°C: 1.500-1.508; Optical Rotation: +9° to +35°; acid value: 0.3-2.4. Indian oil has a much higher 'asarone' content (82%) than commercial oils (7-7.5%). The characteristic odour of the rhizome and oil is ascribed to an unidentified constituent of boiling point 125-135°C.

Uses

The medicinal properties of the calamus plant have been known since the earliest dawn of human history. There are references to it in the early Sanskrit and Chinese literature. Its medicinal action is attributed to its essential oil content. The roots also contain a glucoside called 'acorin.' The oil is reported to cure gastritis and is supposed to promote digestion. It is also administered to animals as a stomachic. The essential oil is also used in stomach and skin diseases; as a vermifuge and antiseptic as well.

The greatest use at present appears to be in the perfumery industry, as a component of the finest perfumes. The dried rhizome is a common bazaar medicine, and is generally used in the form of infusion. It is an aromatic bitter tonic and carminative. It posse.ses emetic and anti-spasmodic properties. It produces beneficial results in cases of dyspepsia and chronic diarrhoea. In large doses, it is emetic.

The powdered rhizome also possesses insecticidal properties and is useful against bed-bugs, moths, lice, etc. The rhizome and its oil are used in the manufacture of liquors, essences and bitters.

TAMARIND

Bot. Name: *Tamarindus indica* Linn.
Family: *Leguminosae*
Hindi, Punjabi, Urdu: *Imli;* Assamese: *Ttali;* Bengali and Gujarati: *Ambli;* Kannada: *Amli; Huli;* Malayalam: *Puli;* Marathi: *Chinch*, *Chincha;* Oriya: *Teetuli*, *Koina*, *Konya;* Sanskrit: *Amli*, *Abdika;* Tamil: *Puli;* Telugu: *Chinthappandu-Chinta*, *Amlika.*

Description and Distribution

The ripe fruit (pod) of the tree (*Tamarindus indica*) is used as condiment, or more precisely, as an 'acidulant,' like *amchur* (dried slices of raw green mango or its powder) or *anardana* (the dried sour pomegranate seeds) or kokam fruit (*Garcinia indica*). Tamarind fruit or tamarind pulp is quite popular all over India, particularly in southern India where tamarind constitutes an essential ingredient of 'sambars,' 'rasams,' chutneys and curries.

India is the only country which produces a commercial crop of tamarind. It is chiefly grown in Madhya Pradesh, Andhra Pradesh, Tamil Nadu and Karnataka States. It is estimated that about 2,50,000 tonnes of the fruit are marketed within the country annually. A few thousand tonnes are exported to West Asia, Europe and America where it is used in Worcestershire sauces.

Composition

Tamarind pulp: The ripe fruit, on an average, comprises about 55% tamarind pulp, 33% seeds and about 12% fibre. A typical sample of tamarind pulp showed the following—moisture: 18.2%; free acid (tartaric): 9.8%; combined acid: 6.7%; total sugars as invert 38.2%; protein: 2.8%; pectin: 2.8%; cellulosive residue (fibre): 19.4%; mineral matter: 2.8%; calcium: 0.17%; phosphorus: 0.11%; iron: 0.011%; calorific value: 283 calories per 100g; vit. A: 100 I.U./100g; niacin: 0.2 mg/100g.

Of the reducing sugars present, 70% is glucose and 30% is

fruit sugar (i.e. fructose). Only a trace of sucrose or cane sugar is present. The pectin present in pulp is of good quality having a jelly grade of 180-200.

Tamarind Juice Concentrate: The CFTRI, Mysore, has developed a process for the manufacture of tamarind concentrate which is free from fibre, seeds, foreign matter, etc. and is very hygienic. Of recent, there is a growing demand for it from abroad. It is almost of jam consistency. It is easily dispensible in hot water at the time of its use.

Tamarind seed consists of 30% testa (outer skin) and 70% endosperm. The testa contains 40% of water-solubles, 80% of which is tannin and colouring matter. The composition of the seed kernel is—moisture: 8.1%; protein: 17%; fat: 7%; crude fibre: 5.6%; non-fibre carbohydrates: 65%; other components: 5.4%; and mineral matter: 2.8%.

The only factors in tamarind pulp and kernel having food value are carbohydrates and protein. They also have small amounts of vitamins, carotene, vit, B_1 and nicotinic acid.

Uses

Practically all the parts of tamarind tree have one use or the other. Ripe fruit or tamarind pulp has an important role in numerous culinary preparations in the country, notably 'Sambhar,' 'Rasam,' curries, chutneys, etc. which are quite popular in the southern parts of India.

An integrated process has been developed at CFTRI, Mysore, for the manufacture of pectin, tartarates and alcohol from tamarind pulp. Likewise, tamarind juice concentrate is also becoming popular in the country as well as abroad.

According to the Ayurvedic system, ripe fruit is appetising, laxative, neating, tonic to the heart, anthelmintic, cures *vata* and *kapha*, heals wounds and fractures. The ripe fruit is also regarded as a refrigerant and digestive and useful in diseases caused by deranged bile, such as burning of the body and intoxication from liquors or *dhatura*. A gargle of tamarind water is recommended in sore-throat.

Seeds/Kernels: The chief use of the seeds lies in the manufacture of textile sizing powder. It is widely used in sizing jute yarn and some cotton yarns. It is only half as costly as starch.

About 3000 tons of tamarind seed powder are used annually in the jute industry alone.

Among the other uses suggested for the kernel are as 'creaming agents' for rubber latex, soil stabilizer and as pectin substitute, because of its jellying property, although structurally or chemically, it is a 'polyose' and is quite different from both pectin and starch.

The *leaves* also find a number of medicinal uses. They are applied to reduce inflammatory swellings and ringworm, etc. and a number of other diseases.

The *flowers* are acrid, sweet, sour, tasty, appetising; cure *vata* and *kapha*, urinary discharges and bad odour in perspiration, etc.

The *unripe fruit* has sour taste and is indigestible, astringent to bowels, cures *vata*, causes biliousness, cough and blood troubles.

The *bark* is used topically for loss of sensation in paralysis. The ash is given for urinary discharges and gonorrhoea. The bark has astringent and tonic properties. It heals ulcers, etc.

The *seeds* are astringent, aphrodisiac, useful in giddiness and vertigo. Applied externally in liver complaints and inflammations.

TARRAGON

Bot. Name: *Artemisia dracunculus* Linn.
Family: *Compositae*

Description and Distribution

The dried leaves and flowering tops of *Artemisia dracunculus* constitute what is known as Tarragon or Estragon, so well-known to the connoisseurs the world over for its unusual intriguing flavour. Sometimes, it is also called 'French Tarragon.' Its aroma is warm, aromatic and reminiscent of

anise. It is a perennial herb found in western Tibet (4265-4880 m) and in Lahul. It is distributed in Afghanistan, western Asia, south and middle Russia. It is cultivated in southern Europe (France, Spain), temperate zones of the USA as well as throughout the colder New England area.

Composition

The dried leaves of tarragon were found to contain—moisture: 4.7%; prosein: 24.2%; fat: 7.3%; fibre: 6.8%; carbohydrates: 44.7%; mineral matter: 12.3%; calcium: 1.3%; phosphorus: 0.31%; iron: 0.034%; sodium: 0.07%; potassium: 3.2%; vit. A: 175 I.U./100g; vit. B_1: 0.2 mg/100g; vit. B_2: 1.34; niacin: 8.9; vit. C: 12.0 mg/100g; Calorific Value: 365 calories/100g.

Volatile Oil: The herb, on steam distillation, yields about 0.3% volatile oil of tarragon which is actually responsible for the aromatic aniseed-like odour of the herb. The volatile oil is reported to have: Sp. gr. 15°C: 0.9 to 0.981; Refr. Index at 20°C: 1.5028 to 1.5160; Opt. Rotation: +2 to +9°; Ester No. 1 to 9; Acetyl No. 15 to 22; Acid No.: 0 to 1; and soluble in 6 to 11 volumes of 80 per cent alcohol. Methyl chavicol is the chief constituent of the volatile oil and phellandrene and ocimene are additional constituents.

Uses

It is used for flavouring vinegar ('terragon vinegar'), pickles, prepared mustard, and to a limited extent for the flavouring of soups, salads, meat dishes, certain cheeses and vegetables.

The aromatic leaves are credited with aperient, stomachic, stimulant and febrifuge properties.

THYME

Bot. Name: *Thymus vulgaris* Linn.: 'Thyme.'
Thymus serpyllum Linn.: 'Wild Thyme.'
Family: *Labiatae*
Hindi: *Banajwain;* Punjabi: *Marizha, Masho, Rangsbur;* Urdu: *Hasha.*

Description and Distribution

The dried leaves and flowering tops of *T. vulgaris* are called 'thyme' and those of *T. serpyllum* 'wild thyme' which is found in the western temperate Himalayas, from Kashmir to Kumaon at an altitude of 1525m above sea level. Thyme is grown in Europe, Australia and North Asia. It is now cultivated in France, Germany, Spain, Italy and other parts of Europe and also in England, North Africa, Canada and the USA. It is a common garden plant which lives for many years under good culture. The dried leaves are curled, of brownish-green colour, usually not longer than 6-7mm and marketed in whole or in ground form. The flavour is aromatic, warm and pungent.

Composition

Thyme herb has the following physico-chemical properties—moisture: 7.1%; protein: 6.8%; fat: 4.6%; crude fibre: 24.3%; carbohydrates: 44.0%; mineral matter: 13.2%; calcium: 2.1%; phosphorus: 0.20%; iron: 0.14 mg/100g; sodium: 0.08%; potasium: 0.9%; vit. A: 175 I.U./100g; vit. B_1: 51 mg/100; vit. B_2: 0.4; vit. C: 12.0 and niacin: 4.9 mg/100. Calorific value: 340 calories per 100g.

Volatile Oil: Crushed thyme on steam distillation, yields about 2.5% volatile oil which is a colourless to yellowish-reddish liquid with a pleasant odour characteristic of the herb and a sharp taste. The volatile oil is found to have the following properties—Sp. gr. 15°C; 0.905-930; Optical Rotation at 20°C; 0 to 4°; Refractive Index at 20°C; 1.480-1.498; Solubility; 1 part in 2 parts of 80 per cent alcohol.

The chief constituent of the oil is thymol (about 45%). In the pure state, thymol consists of colourless, translucent crystals possessing an aromatic thyme-like odour and a pungent taste.

Thymol is in great demand in the country as judged from recent import figures. During 1971-72, India imported 34-204 kg of thymol valued at Rs 11 lakhs. An increase in acreage under thyme should be considered.

The wild thyme yields 0.5% essential oil (as compared to 2.5% in cultivated thyme) containing phenol, etc.

Uses

The herb is used to season tomato soups, 'clam chowder' and juice, fish and meat dishes (particularly poultry dressing). It is also used in liver sausage, pork sausage, head cheese, collage and cream cheese and bockwurst.

The oil of thyme is well recognised for its medicinal properties. It is employed in preparations for use in the treatment of bronchitis and whooping cough. The oil of wild thyme is applied in tooth-ache.

In the Punjab, the herb of wild thyme is given in weak vision, complaints of stomach and liver, suppression of urine and menstruation.

In Europe, it is considered tonic, anti-spasmodic carminative.

An infusion of herb is given in convulsive coughs, whooping coughs, catarrh and sore throat. It is good for nervous or hysterical headaches and for flatulence.

The herb has a sharp pleasant taste; is emmenagogue, alexiteric, anthelmintic; good in liver complaints, pain in the spleen, liver of chest; useful in asthma and bronchitis. It thins phlegm and blood. The leaves are laxative, stomachic, tonic, good for the kidney and eye, and are blood-purifier.

The seeds are given as a vermifuge. Its infusion is also used in skin eruptions/diseases.

TURMERIC

Bot. Name: *Curcuma longa* Linn.
Syn: Curcuma domestica Val.
Family: *Zingiberaceae*
Hindi: *Haldi;* Bengali: *Halud, Haldi, Pitras;* Gujarati: *Haldhar, Haldi;* Kannada: *Arishina;* Konkani: *Halad;* Malayalam: *Manjal;* Marathi: *Halede, Halad;* Oriya: *Haldi;* Punjabi: *Haldar, Haldhar, Haldi;* Sanskrit: *Haladi, Haridra, Harita;* Tamil: *Manjal;* Telugu: *Pasupu;* Urdu: *Haladi.*

Description and Distribution

The spice 'turmeric' or haldi consists of the dried, boiled, cleaned and polished rhizomes (the underground swollen stem of the plant) of *Curcuma-longa.* Turmeric is too well known to need any further description. Suffice it to say that turmeric is one of the most important and ancient spices of India, and a traditional item of export. During 1989-90, turmeric ranked third among the spices exported from India; and earned us foreign exchange to the tune of over 15.7 crores through the export of 16468 metric tons to about 64 countries! In 1987-88 and 1988-89, it ranked second and earned Rs 9 and 19 crores worth foreign exchange respectively. It is used extensively daily by all classes of people in the preparation of tasty curried dishes. Turmeric not only adds its typical flavour but its colour also, thereby helping to bring out the best in curried dishes. Besides, it is also used as dye in certain cotton textiles, in medicine and in cosmetics. Further, it is also regarded by the Hindus as something 'sacred' for use in ceremonial and religious functions.

Turmeric, a herbaceous perennial, 60-90 cm high with a short stem and tufted leaves, native of India or China, is now a commercial crop of the tropics It is cultivated extensively in India, Sri Lanka, parts of China and Indo-China. India is by far the largest producer of turmeric in the world. Besides, in India, turmeric occupies about 6% of the total area under spices and condiments. The main turmeric growing areas are

Andhra Pradesh, Maharashtra, Orissa, Tamil Nadu, Karnataka and Kerala. About 1.8 lakh tons of cured turmeric are produced annually, of which 92% is consumed within the country and it is the remaining 8% which brings us foreign exchange ranging from 4 to 11 crore rupees annually.

Harvesting and Processing (Curing) of Turmeric: Curing of raw turmeric rhizomes freshly dug out of earth is essential both for the development of the attractive yellow colour (mostly due to curcumin pigment) and characteristic aroma, as without it turmeric lacks both. The fingers and bulbs are boiled separately in water for 1/2 to 3/4 hour until froth and white fumes (with characteristic aroma) appear. They are then drained and dried in the sun for 10-15 days until they become dry and hard. At this stage, the fingers produce a metallic sound, when broken with hand. They are then cleaned and polished mechanically in a drum rotated by hand or by power.

Earlier, cowdung used to be added to boiling water to make it alkaline and after removal, the fingers used to be artifically coloured with lead chromate (chemichrome) which is a cumulative poison. CFTRI Mysore has developed a simpler, more hygienic and more efficient technique of curing and colouring of turmeric. According to this technique, the rhizomes are boiled in lime-water or sod. bicarbonate soln. A water solution containing 20 g. sod. bisulphite and 20 g. of hydrochloric acid per 100 lbs of tubers is recommended in place of chemichrome to give them the desired yellow tint. The new process has been demonstrated to the turmeric growers and merchants in A.P. and Tamil Nadu.

Varieties : Under the genus *Curcuma* to which turmeric belongs, the botanists have so far recognised 30 varieties. Of these, *C. longa* is economically the most important accounting for about 96.4% of the total area under turmeric and thc remaining 3,500 acres or 3.6% of the total area are cultivated under *C. aromatica*, which is mostly grown in small areas in East and West Godavari districts of Andhra Pradesh and Tanjavoor and South Arcot districts of Tamil Nadu.

Commercial Quality of Turmeric : By far the largest quantity of turmeric produced in India is utilised as a condiment. Only a small fraction is used in medicine, cosmetics and in dyeing of

textile fabrics. The quality attributes of the commercial produce are its appearance or colour, maturity, weight or bulk density, length and thickness, intensity of colour of the core and aroma, etc. Turmeric produced in different areas is known by various local names. There are as many as 16 such regional qualities (varieties) known in the trade. 'Alleppey turmeric' is considered one of the best in the world, being the richest in colouring matter (curcumin).

Besides, the Agmark Grades have been framed for (*a*) Turmeric Fingers (*b*) Bulbs and (*c*) Powder, separately both for export and for internal trade.

Composition

Turmeric has the following composition-- moisture 5.8%; protein 8.6%; fat 8.9%; carbohydrates 63.0%; fibre 6.9%; mineral matter 6.8%; calcium 0.2%; phosphorus 0.26%; iron 0.05%; sodium 0.01%; potassium 2.5%; vit. A 175 I.U./100g; vit B_1 0.09 mg/100g; vit. B_2 0.19; vit. C 49.8 and niacin 4.8 mg/100g. Calorific value or food energy 390 calories per 100 g.

Volatile Oil: The volatile oil derived from the crushed turmeric tubers is an orange yellow liquid, occasionally slightly flourescent liquid with an odour reminiscent of tubers. The dried rhizomes yield 5-6%, while fresh ones give 0.24% essential oil. About 58% of the oil is composed of turmerones (sesquiterpene ketones) and 9% tertiary alcohols.

Oleoresin : CFTRI, Mysore, has standardized the technique for the manufacture of oleoresin from ground turmeric by solvent extraction followed by vacuum concentration. The semi-liquid viscous stuff contains both the volatile aromatic principles and the non-volatile acrid fractions covering the overall aroma and flavour in a concentrated from, devoid of starchy and fibrous materials. It is in great demand by the food and pharmaceutical industries abroad.

Uses

Turmeric is a unique, colourful and versatile natural plant product combining the properties of (*a*) a spice or flavourant (*b*) colourant as brilliant yellow dye, (*c*) as a cosmetic, (*d*) as a drug useful in a number of diseases, briefly described below.

Of course, turmeric is largely consumed as a spice while only limited quantities are utilised for other purposes.

(i) As Food Flavourant & Colourant : By far the largest quantity of turmeric is utilised in most of the Asiatic countries as a food adjunct in many vegetable, meat and fish preparations. It is used to flavour and at the same time to colour butter, cheese, margarine, pickles, mustard and other foodstuffs.

It is also used to colour liquor, fruit drinks, cakes and table jellies. It is one of the principal ingredients of curry powder which is a blend of many spices, common salt and farinaceous matter.

Turmeric, by dint of its aromatic oil content, flavours foodstuffs, acts as an appetiser and aids digestion. A pinch of turmeric powder is often added to most of our savouries to impart simultaneously an agreeable flavour and colour and to improve the keeping quality.

(ii) As Dye : Earlier, in India, turmeric was largely used for dyeing wool, silk and cotton to impart a yellow shade, in an acid bath. It is still used for dyeing cotton. The dye is also employed as colouring material in pharmacy, confectionery, ricemilling and food industries. Considerable quantities of turmeric are converted as *kumkum* used for *tilak*. Its use as a colouring material is reported in the paints and varnishes industry also.

Turmeric paper is an official reagent in British pharmacopoea for testing alkalinity. A diluted, tincture of turmeric is suitable for use as a fluorescence indicator even in brown and yellow solutions.

Turmeric is an anti-oxidant, due to the phenolic character of curcuma.

(iii) Medicinal Uses : In the Indian system of medicine, turmeric occupies an important place, as an ingredient in the preparation of medicinal oils, ointments and poultice. It is a stomachic, carminative, tonic, blood purifier, vermicide and an antiseptic. It is indicated in case of diabetes and leprosy. It is also prescribed as an anti-periodic alternative. Boiled with warm milk and taken internally, or used as an inhalation from boiling water, or as a smoke through pipe in combination with omum, it relieves sore throat and common cold.

The juice of the raw rhizomes is used an anti-parasitic for many skin affections. In small-pox, it is applied as a paste with gingelly oil and neem leaves. Burnt turmeric used as tooth powder relieves dental troubles. The juice of turmeric rhizomes is believed to relieve purulent ophthalmia.

The essential oil of turmeric is antiseptic. Turmeric is useful in treating gall stones and gall complaints.

(iv) Use in Cosmetics : Apart from sentiment, turmeric and turmeric preparations like *kumkum* and *parani* serve the Hindu women as inexpensive and indigenous beauty aids in their toilet. Smearing turmeric paste on the face and limbs during a bath is found to clear the skin and beautify the face. Its antiseptic and healing properties are said to be both a preventive and cure for that much-feared malady of adolescence—pimples. It is also known to discourage unwanted hair on the feminine skin.

VANILLA

Bot. Name : *Vanilla fragrans* (Salisbury) Ames.
Syn : *Vanilla planifolia* Andrews.
Family : *Orchidaceae*
Hindi, Kannada, Punjabi, Malayalam, Tamil and Urdu: *Vanilla*

Description and Distribution

The vanilla pods or sticks of commerce are the cured fruits or beans of climbing orchid *V. fragrans* or *V. planifolia.* It is a native of Atlantic coast from Mexico to Brazil. Vanilla cultivation spread to other countries after the discovery of America. The important vanilla producing countries are: Madagascar, Mexico, Tahiti, Comorro, Reunion, Indonesia, etc. The world production of cured vanilla is about 1230 tons. The exports from the above countries figure around 9 lakh kg. valued at

12 million dollars (i.e. Rs. 9 crores). Now Malagasy Republic alone grows about 80% of the world crop of vanilla beans.

Though vanilla was introduced into India as early as in 1835, not much headway has been made so far in extending the area under this crop, despite the universal popularity in its use in numerous sweet dishes, notably pudding, chocolate, confectionery and ice-cream industries, etc. within the country. Vanilla worth Rs 1.2 to 4 lakhs is being imported into India annually, in addition to the import of huge quantities of vanillin and vanilla essence. During 1981-82, following were the imports :

Vanilla & Vanilla products	*Quantity (kg)*	*Value (lakhs of Rs)*
Vanilla	1,200	1.20
Vanillin	24,616	11.25
Ethyl Vanillin	6,904	5.11
Iso-Eugenol (used partly for the manufacture of Vanillin)	5,018	3.25
Total		20.81

This is in addition to the synthetic vanillin being produced in the country itself. It is a matter of serious concern that valuable foreign exchange worth about Rs 21 lakhs is being drained from the country. Concerted efforts should be made to extend the area under this valuable crop in suitable localities by training the prospective farmers in various aspects of vanilla farming, such as hand pollination vs. hormone spray, curing and processing of vanilla beans, their packaging and storage based on the useful researches being conducted at the Central Horticultural Research Station, Ambalavayal (Wynaad, Kerala) and elsewhere. India has ideal agro-climatic conditions for the cultivation of vanilla, but at present, it is grown in only about 30 acres in Wynaad (Kerala) and the Nilgiris (Tamil Nadu). Thus, there is ample scope for extending the area, notably in Kerala, and at least in home-gardens, especially in arecanut and coconut gardens where irrigation facilities are available. The major bottle-neck of hand pollination may be overcome through hormone sprays.

The ISO (International Organization for Standardization) have included the following 2 species of vanilla in the list of spices in addition to *V. fragrans* mentioned above.

1. *Vanilla pompona* Schneider.
2. *Vanilla tahitensis* Moore.

Harvesting and Curing

Different methods of curing vanilla after harvest are being followed in different countries. Of the various processes tried at Ambalavayal Farm, curing vanilla by the Mexican Process has been found to be the best under Wynaad conditions, both for their attractive appearance and high aroma or vanillin content (2.3-2.9%). During curing (fermentation) process, vanilla pods get the flavour as a result of naturally induced enzymatic action of β-glucosidase on the precursor glucovanillin with the formation of vanillin and sugar. Vanillin aroma is the dominant flavour characteristic of vanilla. Climatic conditions, timing of the harvest, and the extent of sweating of the pods during curing, are some of the important factors that determine the vanillin content and quality of the pods. About 1/2 kg of cured beans can be obtained from 3.5 to 4 kg. of green vanilla beans.

Quality Attributes of Vanilla : The most important quality attributes of cured vanilla beans for grading purposes are: length of beans, aroma, colour, flexibility, lustre, and freedom from blemishes, mildew and insect infestation. The best quality pods are 17-25 cm long, highly aromatic, free from mildew, blemishes and insect infestation, dark brown in colour, fleshy, supple and somewhat oily in appearance. It may be cautioned here that the quality of vanilla beans should not be judged only by their vanillin content since, frequently, the very finest quality beans show much less vanillin content. The well-cured beans thus graded and packed in air-tight tin containers can keep well for a long time.

Composition

The proximate composition of whole vanilla beans is as under —moisture 25.85-30-93%; protein 2.56-4.87%; fatty oil 4.68-6.74%; volatile oil 0.0 to 0.4%; nitrogen-free extract

30.35-32.90%; carbohydrates 7.1-9.1%; fibre 15.27-19.6%; ash 4.5-4.7%; vanillin 1.48-2.90%; resins 1.5-2.6%; calcium 19.7%; potassuim 16.2%; sodium 6.7%; phosphorus 9.5%; iron 0.3%.

Adulteration/Substitution

Vanilla beans contain methyl vanillin but ethyl vanillin is synthetic and more aromatic than methyl vanillin. The choice between methyl and ethyl vanillin depends on the preparation and the end use. *Ethavan* and *Vanaldol* are the trade names of ethyl vanillin.

Synthetic vanillin can be used in the place of true vanilla for cheap flavourings such as vanillin solution and vanillin sugar. Coumarin, a compound with a vanilla-like flavour can be used as a cheap substitute for vanilla. However, since it has recently proved to be toxic, its use for flavouring foods should be banned.

The appearance and odour of the spent (solvent treated) vanilla beans is reported to be improved by treating them with benzoic acid. In the event of suspicion, a simple test can be conducted by heating the crystals over a flame which will emit irritating odour due to the presence of benzoic acid.

Vanilla Extracts/Essences

Vanilla extracts are in great demand in America while cured vanilla beans in European countries. The vanilla flavour can be extracted with alcohol. The colour of the extract depends on the strength of the alcohol used, duration of extraction and the presence of glycerin. Dark coloured extract is obtained from dry beans and the presence of glycerin deepens the colour of the extract. Vanilla extract is either stored in stainless, aluminium or glass containers. Ageing for 25-30 days improves the aroma, due to formation of esters from acids in the presence of 42-45% alcohol. Wooden containers should be avoided completely as they adversely affect its flavour because of the alcoholic extractions from the wood itself.

However, it may be added that the cost of natural vanilla extract is about 20 times that of the synthetic vanilla flavouring. Of course, these imitation flavours are inferior to the natural ones.

Vanilla Sugar

The vanilla extract is mixed with sugar and made into a powder called 'powdered vanilla' or vanilla sugar.

Uses

(i) **Vanilla**—(*a*) *As Food Flavourant & in Perfumery.* Vanilla, today, constitutes the world's most popular flavouring for numerous sweetened foods. 'Vanilla Sugar' is used in the manufacture of chocolates. 'Vanilla flavouring' is used in countless commercial food products, in liquor, in cheap brandy and in whisky. In the USA, most of the vanilla flavour is marketed in the form of pure vanilla extracts, widely used as a flavouring *par excellence* for ice-creams, soft drinks, chocolate, confectionery, candy, tobacco, baked foods, puddings, cakes, cookies, liquors and as a fragrantly tenaceous ingredient of perfumery.

The medicinal uses of vanilla have gradually reduced. It is no longer regarded as a drug. However, it is still the most lovable flavourant.

(ii) **Vanillin**—Till recently, the bulk of the vanillin produced was used as a flavouring agent in different foods. The remaining quantity was used in deodorants, perfumes, odour fixatives, and as a masking agent in pharmaceutical and vitamin preparations.

After 1970, the greatest use for the technical grade vanillin (98% pure, less desirable for food flavouring) is a chemical intermediate in the production (synthesis) of a number of pharmaceutical products. Foaming in lubricating oils can be prevented by the use of vanillin. Vanillin can be used as a brightener in zinc plating baths. It can also be used as an aid for the oxidation of linseed oil and as solubilizing agent for riboflavin (vitamin B_2) as vanillin is an anti-oxidant.

ANNEXURE-I

EXPORT OF SPICES FROM INDIA DURING THE LAST 3 YEARS (1987-88 to 1989-90)

Quantity : in M. Tons, *Value* : in Rs. '000)

Commodity	1987-88		1988-89		1989-90	
	Qty.	*Value*	*Qty.*	*Value*	*Qty.*	*Value*
Pepper	41011	2405778	38020	1642024	36601	1598774
Cardamom (Small)	270	34003	760	98800	171	31941
Cardamom (Large)	155	7022	570	21946	598	25562
Chillies	6122	83345	7926	187228	10713	209876
Ginger	2628	48899	6228	95315	7315	127153
Turmeric	8747	92272	18996	193757	16468	157242
Curry Powder	2559	43810	3093	54164	3107	60247
Coriander	892	13947	8149	58896	2761	28904
Cumin	913	24822	1106	37347	3252	61934
Celery	2492	24063	2526	26550	2524	30345
Fennel	802	15382	1075	21569	2308	31607
Fenugreek	2194	19984	3804	38749	4773	33301
Other Seed Spices	415	7386	1132	22938	1156	12107
Garlic	242	1944	4049	20472	1788	9295
Other Misc. Spices	409	8469	1905	33725	5750	99943
Spices Oils & Oleoresins	428	149677	487	182974	601	225377
GRAND TOTAL	70279	2980803	99826	2736462	99886	2743608

Sources : Upto 1987-88 daily list of Exports published by Customs 1988-89 & 89-90 DGCI & S., Calcutta and Shipping Bills passed by Customs. Figures are strictly provisional and subject to revision.
Compiled by Spices Board, Govt. of India, Cochin-18.

ANNEXURE II

STATE-WISE PRODUCTION ESTIMATES OF MAJOR SPICES IN INDIA DURING 1984-85

(In thousand tons)

	Production in Thousand Tons							
State	*Cardamom*	*Chillies*	*Coriander*	*Garlic*	*Ginger*	*Onion*	*Pepper*	*Turmeric*
Andhra Pradesh	—	231.5	38.5	2.0	5.34	112.6	—	79.6
Assam	—	38.5	—	—	—	11.0	—	5.3
Bihar	—	12.4	2.2	2.4	1.22	126.7	—	7.3
Gujarat	—	14.0	—	101.0	0.25	491.1	—	—
Haryana	—	8.2	0.1	8.7	0.02	34.5	—	—
Himachal Pradesh	—	0.1	0.1	—	0.98	1.8	—	—
Jammu & Kashmir	—	0.3	0.3	0.1	—	1.0	—	—
Karnataka	1.8	43.7	3.4	3.6	3.39	243.3	0.67	8.9
Kerala	2.0	0.9	—	—	34.39	2.7	19.38	5.8
Madhya Pradesh	—	14.6	12.6	42.2	3.31	190.7	—	0.4
Maharashtra	—	70.3	—	31.5	0.57	759.1	—	12.9
Manipur	—	2.5	—	—	0.53	—	—	—
Meghalaya	—	1.0	—	—	28.56	—	—	2.8
Nagaland	—	0.8	—	0.1	Neg.	0.4	—	—
Orissa	—	72.9	10.0	78 0	12.82	314.5	—	41.0
Punjab	—	4.8	—	1.5	—	15.2	—	—
Rajasthan	—	30.1	29.4	3.8	0.75	46.5	—	0.5
Sikkim	3.8	—	—	—	8.70	—	—	—
Tamil Nadu	0.5	42.5	22.2	2.9	1.49	229.1	0.59	69.8
Tripura	—	0.6	—	—	0.87	0.2	—	1.7

Uttar Pradesh	—	16.0	3.0	13.8	4.26	262.0	—	0.7
West Bengal	0.6	23.2	—	—	5.89	—	—	7.8
Arunachal Pradesh	—	0.6	—	—	1.53	—	—	0.3
Delhi	—	0.1	—	—	—	1.3	—	Neg.
Mizoram	—	2.2	—	—	7.99	—	—	0.3
Pondichery	—	0.1	—	—	—	0.1	Neg.	—
ALL INDIA	8 7	605.4	121.4	292.5	122.85	2870 0	20.64	243.8

Source : Directorate of Economics and Statistics, Govt. of India, New Delhi-1

ANNEXURE II-A

ALL INDIA FINAL ESTIMATES OF AREA, PRODUCTION AND YIELD OF IMPORTANT SPICES GROWN IN INDIA DURING 1986-87 & 1985-86

Spices	*Area/ Production/ Yield*	*1986-87*	*1985-86*	*% Increase (+) or decrease (−) in col. 3 over 4*
Black Pepper	Area	136.62	125.12	(+) 9.2
	Production	32.85	34.00	(−) 3.4
	Av. yield	240.45	271.83	(−) 31.4
Cardamom	Area	116.79	117.74	(−) 0.8
	Production	9.73	10.02	(−) 2.9
	Av. yield	83.31	85.10	(−) 1.8
Chillies	Area	814.10	904.10	(−) 10.0
	Production	780.00	877.40	(−) 11.1
	Av. yield	958.11	970 47	(−) 12.4
Ginger	Area	52.46	53.52	(−) 2.0
	Production	127.00	138.02	(−) 8.0
	Av. yield	2420.89	2578.85	(−) 158.0
Turmeric	Area	102.50	109.20	(−) 6.1
	Production	280.60	367.10	(−) 23.6
	Av. yield	2737.56	3361.72	(−) 624.2
Onion	Area	266.90	280.60	(−) 4.9
	Production	2719.60	2862.70	(−) 5.0
	Av. yield	10189.58	10202.07	(−) 12.5
Garlic	Area	57.80	57.70	(+) 0.2
	Production	206.00	189.60	(+) 8.6
	Av. yield	3564.01	3285.96	(+) 278.05
Coriander	Area	351.20	382.10	(−) 8.1
	Production	167.00	117.10	(+) 42.6
	Av. yield	475.51	306.46	(+) 169.1

Source : Directorate of Economics and Statistics, Dept. of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India, New Delhi-1.

Area in '000 ha; Production in '000 tonnes; Av. yield kg/ha.

ANNEXURE III

PFA Definitions & Quality Standards for Spices (Whole & Ground)

as laid down under the

Prevention of Food Adulteration (PFA) Act & Rules 1954 (Amended upto Oct. 27, 1984)

N.B.—Spices below have been arranged alphabetically irrespective of the PFA code number alloted to them.

A.05 23 —'Ajowan' or Bishop's Weed' means the dried ripe seeds of *Trachy-spermum ammi* (Linn) Sprague. The proportion of organic and inorganic extraneous matter shall not exceed 3 per cent and 2 per cent respectively. The seeds shall be free from living insects, insect fragments and rodent contamination visible to the eyes. It shall be free from added colour.

Note : (1) The extraneous matter wherever prescribed under this item, shall be classified as follows:

(a) Organic extraneous matter such as chaff, stems & straw.

(b) Inorganic extraneous matter such as dust, dirt, stone and lumps of earth.

(2) Of the permitted extraneous matters in items. A. 05.01, A. 05.03, A. 05.04, A. 05.05, A. 05.07, A. 05.08, A. 09, A. 05.10, A. 05.13, A. 05.14, A. 05.15, A. 05.16, A. 05.17 and A. 05.18, the inorganic extraneous matter shall not exceed 2 per cent by weight.

A. 05.22—Aniseed or 'Saunf imported' means the dried ripe fruit of *Pimpinella anisum.* Foreign edible seeds or matter shall not exceed 5.0 per cent by weight. It shall conform to the following standards:

(a) Total ash : Not more than 9 per cent by weight.

(b) Ash insoluble in dilute HCl : Not more than 1.5%.

(c) Volatile oil : Not less than 1.0 per cent (v/w).

The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

Explanation:—The term 'insect damaged matter' means spices that are partially or wholly bored by insects.

A. 04.—**Asafoetida (Hing or Hingra)** means the oleo-gum-resin obtained from the rhizome and roots of Ferula *alliaces Farula rubriculist* and other species of Ferula. It shall not contain any colophony resin, galbonum resin, ammoniaccum resin, or any other foreign resin.

Hing shall conform to the following standards, namely—

(1) Total ash content shall not exceed 15% by wt.

(2) Ash insoluble in dilute hydrochloric acid shall not exceed 2.5 per cent by weight.

(3) The alcoholic extract (with 90 per cent alcohol) shall not be less than 12 per cent as estimated by the U.S.P. 1936 method.

(4) Starch shall not exceed 1 per cent by weight.

Hingra shall conform to the following standards, namely—

(1) The total ash content shall not exceed 20% by wt.

(2) Ash insoluble in dilute hydrochloric acid shall not exceed 6 per cent by weight.

(3) The alcoholic extract (with 90 per cent alcohol) shall not be less than 50 per cent as estimated by U.S.P. 1936 method.

(4) Starch shall not exceed 1 per cent by weight.

'Compounded asafoetida' or 'Bandhani Hing' is composed of one or more varieties of asafoetida **Irani** or **Pathani Hing** or both) and gum arabic, edible starches or edible cereal flour. It shall not contain:

(a) colophony resin,

(b) galbanum resin,

(c) ammoniaccum-resin,

(d) any other foreign resin,

(e) coal tar dyes,

(f) mineral pigment,

(g) more than 10 per cent total ash content.

(h) more than 1.5 per cent ash insoluble in dilute HCl.

A. 05.01—**Caraway Whole** means the dried seed of the plant *Carum carvi* (L). Extraneous matter including foreign edible

seeds, chaff, stem, straw, dust, dirt, stones, and lumps of earth shall not exceed 5 per cent by weight. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.01.01— **Caraway or Siah Jira Powder** means the powder obtained from the dried seed of *Carum carvi* (L). It may be in the form of small pieces of the seeds or in finely ground form. It shall conform to the following standards:
Moisture : Not more than 13.0 per cent by weight.
Total ash : Not more than 8.0 per cent by weight.
Ash insoluble in dilute HCl : Not more than 1.5 per cent.
It shall be free from added colouring matter.

A. 05.02—**Caraway Black Whole (Siah Jira)** means the dried seeds of *Carum bulbocastanum*. It shall conform to the following standards :
Foreign edible seeds: Not more than 5.0% by wt.
Total ash : Not more than 9.0 per cent by weight.
Ash insoluble in dilute HCl : Not more than 1.5% by wt.
The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.03—**Cardamom Whole** (*Chhoti Elachi*) means the dried, nearly ripe, fruits of *Elettaria cardamomum* (L). The percentage of extraneous matter shall not exceed 5.0 per cent by weight. The cardamom seeds obtained from the capsules shall contain not less than 3.0 per cent (v/w) of volatile oil. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.03.01—**Cardamom Seeds** (*Chhoti Elachi*) means the seeds obtained by separating the seed from the capsules of *Elettaria cardamomum* (L). The percentage of extraneous matter in the seeds shall not exceed 2.0 per cent by weight. The seeds shall contain not less than 3.0 per cent (v/w) of volatile oil. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.03.02—**Cardamom Powder** (*Chhoti Elachi*) means the powder obtained from the seeds separated from the capsules of *Elettaria cardamomum* (L). It may be in the form of small pieces of the seeds or in finely ground form. It shall conform to the following standards:

Moisture: Not more than 14.0 per cent by weight.
Total ash: Not more than 8.0 per cent by weight.
Volatile oil: Not less than 3.0 per cent (v/w).
It shall be free from added colouring matter.

A. 05.04—**Cardamom amomum Whole** (*Badi Elachi*) means the dried, nearly ripe fruit of *Amomum subulatum* Roxb. in the form of capsules. The proportion of calyx pieces, stalk bits and other extraneous matter shall not exceed 5.0 per cent by weight. The cardamom amomum seeds obtained from the capsules shall contain not less than 1.0 per cent (v/w) of volatile oil. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05 04.01—**Cardamom amomum Seeds** (*Badi Elachi*) means the seeds obtained by separating the seeds from the cardamom amomum capsules of *Amomum subulatum* Roxb. The percentage of extraneous matter in the seeds shall not exceed 2.0 per cent by weight. They shall contain not less than 1.0 per cent (v/w) volatile oil. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.04.02—**Cardamom amomum Powder** (*Badi Elachi*) means the powder obtained from the seeds separated from the capsules of *Amomum subulatum* Roxb. It may be in the form of small pieces of the seeds or in finely ground form. It shall conform to the following standards:

Moisture: Not more than 14.0 per cent by weight.
Total ash: Not more than 8.0 per cent by weight.
Volatile oil : Not less than 1.0 per cent (v/w).
Ash insoluble in dilute HCl : Not more than 3.0% by wt.
It shall be free from added colouring matter.

A. 05.05—**Chillies (Lal Mirchi) Whole** means the dried ripe fruits or pods of *Capsicum annum/Capsicum frutescens* (L).

The proportion of extraneous matter including calyx pieces, loose tops, dirt, lumps of earth, stones shall not exceed 5.0 per cent by weight. The pods shall be free from extraneous colouring matter, coating of mineral oil and other harmful substances. The amount of insect damaged matter shall not exceed 5 per cent by weight.

A. 05.01 – **Chilli (Lal Mirchi) Powder** means the powder obtained by grinding clean dried chilli pods of *Capsicum frutescens* L/*Capsicum annum.* The chilli powder shall be dry, free from dirt, mould growth, insect infestation, extraneous matter, added colouring matter (and flavouring matter). The chilli powder may contain any edible oil to a maximum limit of 2 per cent by weight under a label declaration for the amount and the nature of the oil used. The chilli powder shall conform to the following standards:
Moisture: Not more than 12.0 per cent by weight.
Total ash: Not more than 8.0 per cent weight.
Ash insoluble in dilute HCl: Not more than 1.3% by wt.
Non-volatile ether extract: Not less than 12.0% by wt.
Crude fibre: Not more than 30.0 per cent by weight.

A. 05.06—**Cinnamon** (*Dalchini*) **Whole** means the dried pieces of the inner bark of *Cinnamomum zeylanicum* Blume. It shall not contain any other foreign vegetable matter or colouring matter. It shall contain not less than 0.5 per cent (v/w) of volatile oil, The amount of insect damaged matter shall not exceed 5 per cent by weight.

A. 05.06.01—**Cinnamon** (*Dalchini*) **Powder** means the powder obtained by grinding the dried inner bark of *Cinnamomum zeylanicum* (Blume). The cinnamon powder shall conform to the following standards:
Moisture: Not more than 12.0 per cent by weight.
Total ash: Not more than 8.0 per cent by weight
Ash insoluble in dilute HCl : Not more than 2.0% by wt.
Volatile oil : Not less than 0.5 per cent (v/w).
It shall be free from added colouring matter.

A. 05.06.02 – **Cassia Tej Whole** means dried pieces of bark of *Cinnamomum cassia* Blume, Syn. *Cinnamomum arometicum.*

Nees (Chinese Cinnamon, or Cassia Lignea). It shall not contain any other foreign vegetable matter or colouring matter.

A. 05.07—**Cloves** (*Laung*) **Whole** means the dried unopened flower buds of *Eugenia caryophyllus* Thumb. The extraneous matter shall not exceed 5.0 per cent by weight. The cloves shall contain not less than 15.0 per cent (v/w) of volatile oil. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.07.01—**Cloves** (*Laung*) **Powder** means the powder obtained by grinding the dried unopened flower buds of *Eugenia caryophyllus* Thumb. The cloves powder shall conform to the following standards:
Moisture: Not more than 12.0 per eent by weight.
Total Ash: Not more than 7.0 per cent by weight.
Ash insoluble in dilute HCl: Not more than 0.5% by wt.
Volatile oil: Not less than 15.0 per cent (v/w).
It shall be free from added colouring matter.

A. 05.08—**Coriander** (*Dhania*) **Whole** means the dried mature fruits (seeds) of *Coriandrum sativum* (L). The proportion of extraneous matter including dust, dirt, stones, lumps of earth, chaff, stalk, stem or straw, edible seeds of fruits other than coriander and insect damaged seeds shall not exceed 8.0 per cent by weight. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.08.01—**Coriander** (*Dhania*) **Powder** means the powder obtained by grinding clean dried coriander fruits of *Coriandrum sativum* (L). It shall be in the form of a rough or fine powder.
Moisture : Not more than 12.0 per cent by weight.
Total ash : Not more than 7.0 per cent by weight.
Ash insoluble in dilute HCl: Not more than 1.5% by wt.
It shall be free from added colouring matter.

A. 05.09—**Cumin** (*Safed Jeera*) **Whole** means the dried seeds of *Cuminum cyminum* (L). The proportion of extraneous matter including dust, stones, lumps of earth, chaff, stem or straw

shall not exceed 7.0 per cent by weight. The proportion of edible seeds other than cumin seeds shall not exceed 5.0 per cent by weight. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.09.01—**Cumin** (*Safed jeera*) **Powder** means the powder obtained by grinding the dried seeds of *Cuminum cyminum*(L). The powder shall conform to the following standards:
Moisture : Not more than 12.0 per cent by weight.
Ash insoluble in dilute HCl : Not more than 1.5 per cent by weight.
It shall be free from added colouring matter.

A. 05.10 – **Cumin Black** (*Kalonji*) **Whole** means the dried seeds of *Nigella sativa* L. The proportion of extraneous matter including dust, dirt, stones, lumps of earth, chaff, stem or straw shall not exceed 7.0 per cent by weight. The proportion of edible seeds other than cumin black shall not exceed 5.0 per cent by weight. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.10.01—**Cumin Black** (*Kalonji*) **Powder** means the powder obtained by grinding the dried seeds of *Nigella sativa* L. The powder shall conform to the following standards:
Moisture : Not more than 12.0 per cent by weight.
Total ash: Not more than 7.0 per cent by weight.
Ash insoluble in dilute HCl : Not more than 1.5% by wt.
Volatile oil : Not less than 0.5 per cent (v/w).
It shall be free from added colouring matter.

A. 05.11 – **Fennel** (*Saunf*) **Whole** means the dried ripe fruits of *Foeniculum vulgare* Mill. The proportion of extraneous matter including dust, dirt, stone, lumps of earth, chaff, stem or straw shall not exceed 5.0 per cent by weight. The proportion of edible seeds other than fennel shall not exceed 5.0 per cent by weight. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.11.01—**Fennel** (*Saunf*) **Powder** means the powder obtained

by grinding the dried ripe fruits of *Foeniculum vulgare* Mill. The powder shall conform to the following standards:
Moisture : Not more than 12.0 per cent by weight.
Total ash : Not more than 9.0 per cent by weight.
Ash insoluble in dilute HCl : Not more than 2.0% by wt.
Volatile oil : Not less than 1.0 per cent (v/w).
It shall be free from added colouring matter.

A. 05.12—**Fenugreek** (*Methe*) **Whole** means the dried ripe seeds of *Trigonella foenum-groecum* L. The proportion of extraneous matter including dust, dirt, stones, lumps of earth chaff, stem or straw shall not exceed 5.0 per cent by weight. The proportion of edible seeds other than fenugreek shall not exceed 5.0 per cent by weight. The amount of insect demaged matter shall not exceed 5 per cent by weight It shall be free from added colouring matter.

A. 05.12.01—**Fenugreek** (*Mathe*) **Powder** means the powder obtained by grinding the dried ripe seeds of *Trigonella foenum-groecum* L. The powder shall conform to the following standards:
Moisture : Not more than 10.0 per cent by weight.
Total ash : Not more than 7.0 per cent by weight.
Ash insouble in dilute HCl : Not more than 2.0% by wt.
Cold water-soluble extract : Not less than 30.0% by wt.
It shall be free from added colouring matter.

A. 05.13—**Ginger** (*Sonth*, *Adrak*) **Whole** means the rhizomes of *Zingiber officinale* Rose in pieces irregular in shape and size with peel not entirely removed, washed and dried in the sun. The proportion of extraneous matter shall not exceed 2.0 per cent by weight. It shall contain, on dry basis, not less than 10 per cent (v/w) of volatile oil. If the ginger is limed, the lime (Calcium oxide) content shall not exceed 4.0 per cent by weight on dry basis. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

A. 05.13.01—**Ginger** (*Sonth*, *Adrak*) **Powder** means the powder obtained by grinding ginger (*Zingiber officinale Rosc.*) whole. The powder shall conform to the following standards:

Moisture: Not more than 13.0% by wt.
Total ash : Not more than 8.0% by wt.
Ash insoluble in dilute HCl : Not more than 1.0% by wt.
Water-soluble ash: Not less than 1.7 per cent by weight.
Cold water-soluble extract : Not less than 10.0% by wt.
Calcium (as Ca0) : Not more than 4.0% by wt.
Alcohol (90 per cent v/w) soluble extract : Not less than 4.5 per cent by weight.
It shall be free from added colouring matter.

A. 05.14— **Mace** (*Jalpatri*) **Whole** means the dried coat or arilus of the seed of *Myristica fragrans* Houtt. It shall not contain the arilus of any other variety of *Myristica malabarica* or Fatua (Bombay mace) and *Myristica argentiea* (wild mace). The proportion of extraneous matter shall not exceed 3.0 per cent by weight. It shall be free from added colouring matter.

A. 05.14.01—**Mace** (*Jalpatri*) **Powder** means the powder obtained by grinding the dried coat or arilus of the seed *Myristica fragrans* Houtt. The powder shall conform to the following standards:
Moisture: Not more than 10.0% by wt.
Total ash: Not more than 3.0% by wt.
Ash insoluble in dilute HCl : Not more than 1.0% by wt.
Crude fibre : Not more than 10.0 per cent by weight.
Non-volatile ether extract : Not less than 20.0 and not more than 30.0 per cent by weight.
The amount of insect damaged matter shall not exceed 5% by weight. It shall be free from added colouring matter.

A. 05.15 — **Mustard** (*Rai. Sarson*) **Whole** means the dried seeds of *Brassica alba* (L). Boiss (Safedrai), *Brassica Compestris* L. var *dichotoma* (Kali Sarson), *Brassica compestris* L. Var, yellow Sarson Syn. *Brassica Compestris* L. var. *glauca* (pili Sarson), *Brassica compestris* L. var, *toria* (Toria), *Brassica juncea* (L), Coss, et Czen (Rai, Lotni) and *Brassica nigry* (L) Koch (Benarasi rai). The proportion of extraneous matter which includes dust, dirt, stones, lumps of earth, chaff, stem, straw, edible foodgrains, edible oilseeds of any other variety or any other impuritely shall not exceed 7.0 per cent by weight. It shall be free from seeds of *Argemone mexicana*

Linn. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from added colouring matter.

Note : Since toria belongs to the class of *Brassica compestris*, it is included in the definition of mustard seed.

A. 05.15.01—**Mustard** (*Rai*, *Sarson*) **Powder** means the powder obtained by grinding the dried seeds of *Brassica alba* (L). Boiss (Safed rai), *Brassica compestris* L. var. *dichotoma* (Kali Sarson), *Brassica compestris* L. var. (yellow Sarson) syn. *Brassica compestris* L. var. *glauca* (Pili Sarson). *Brassica compestris* L. var. toria (Toria). *Brassica juncea*, (L) Coss. et. Czern, (Rai, Lotni), and *Brassica nigra* (L). Koch. (Benarasi rai). The powder shall conform to the following standards:

Moisture : Not more than 7.0 per cent by weight.

Total ash: Not more than 8.0 per cent by weight.

Volatile oil : Not less than 0.25 per cent v/w.

Ash insoluble in dilute HCl : Not more than 2.0 per cent by weight.

Crude fibre : Not more than 8.0 per cent by weight.

Starch : Not more than 15.0 per cent by weight.

The test for argemone oil shall be negative.

It shall be free from added colouring matter.

A. 05.16—**Nutmeg** (*Jaiphal*) **Whole** means the dried seeds of *Myristica fragrans* Houtt. The proportion of extraneous matter and infestation shall not exceed 3.0 per cent by weight. It shall be free from added colouring matter.

A. 05.16.01—**Nutmeg** (*Jaiphal*) **Powder** means the powder obtained by grinding the dried seed of *Myristica fragrans* Houtt. The powder shall conform to the following standards:

Moisture : Not more than 8.0 per cent by weight.

Total ash : Not more than 5.0 per cent by weight.

Ash insoluble in dilute HCl : Not more than 0.5% by wt.

Crude fibre : Not more than 10.0 per cent by weight.

It shall be free from added colouring matter.

A. 05.17—**Pepper Black** (*Kali mirch*) **Whole** means the dried berries of *Piper nigrum L.* brown to black in colour with wrinkled surface. The proportion of extraneous matter

including dust, stalks, leafy matter and other foreign matter shall not exceed 3.0 per cent by weight. The proportion by weight of light berries and pinheads shall not exceed 10.0 per cent and 4.0 per cent respectively. The amount of insect damaged matter shall not exceed 5 per cent by weight. It shall be free from colouring matter.

A. 05.17.01—**Pepper Black** (*Kali mirch*) **Powder** means the powder obtained by grinding the dried berries of *Piper nigrum L.* and shall be without the addition of any other matter. The powder shall conform to the following standards:
Moisture: Not more than 12.5 per cent by weight.
Total ash: Not more than 8.0 per cent by weight.
Ash insoluble in dilute HCl : Not more than 1.2% by wt.
Crude fibre : Not more than 18.0 per cent by weight.
It shall be free from added colouring matter.

A. 05 17.02—**Light Black Pepper** means the dried berries of *Piper nigrum* L dark brown to dark black in colour. It shall be well dried and free from mould or insects and shall not contain more than 6 per cent extraneous matter including dust, stone, lump of earth, stalks, leafy matters and other foreign edible seeds and 10 per cent pinheads. It shall be free from added colouring matter.

A. 35.17.03—**Pinheads**—shall be wholly derived from the spikes of *Piper nigrum*. They shall be reasonably dry and free from insects. The colour shall be from dark brown to black. The extraneous mettar shall not exceed 6 per cent. It shall be free from added colouring matter.

A. 05.18—**Poppy Seeds** (*Khas-Khas*) **Whole** means the dried seeds of the ripe fruit of *Papaver somniferum* L. The seed may be white or greyish in colour. The proportion of extraneous matter shall not exceed 15.0 per cent by weight. It shall contain not less than 40.0 per cent by weight of non-volatile ether extract.
It shall be free from added colouring matter.

A. 05.19—**Saffron** (*Kesar*) means the dried stigmata or tops of styles of *Crocus sativus* L. It shall not contain any foreign

colouring matter or any other extraneous matter. It shall conform to the following standards :

Total ash : Not more than 8 per cent by weight.

Ash insoluble in dilute HCl : Not more than 1.5 per cent by weight.

Volatile-matter at 10 ° ± 1°C : Not more than 14 per cent by weight.

Aqueous extract : Not less than 55 per cent by weight.

Total Nitrogen (on dry wt. basis) : Not less than 5 per cent by weight.

Foreign matter such as sand, earth, dust, leaf, stem, chaff and vegetable matter : Not more than 1 per cent.

Floral waste defined as yellow filaments, pollen, stamens, parts of flowers of *Crocus sativus* Linn : Not more than 15 per cent.

Saffron shall be free from living insects, moulds and shall be practically free from dead insects, insect-fragments and rodent contamination visible to naked eye.

A. 05.20—**Turmeric** (*Haldi*) **Whole** means the dried rhizome or bulbous roots of the plant of *Curuma longa* L. It shall be free from lead chromate and other artificial colouring matter. The proportion of extraneous matter shall not exceed 2.0% by wt. The amount of insect damaged matter shall not exceed 5% by wt.

A. 05.20.01—**Turmeric** (*Haldi*) **Powder** means the powder obtained by grinding the dried rhizomes or bulbous roots of the plant of *Curcuma longa* L. It shall be free from artificial colouring matter. The powder shall conform to the following standards :

Moisture : Not more than 13.0% by wt.

Total ash : Not more than 9.0% by wt.

Ash insoluble in dilute HCl : Not more than 1 5% by wt.

Test for lead chromate : Negative

Total starch per cent by weight : Not more than 60.0%

A. 05.21—**Curry Powder** means the powder obtained from grinding clean, dried and sound spices belonging to the group of aromatic herbs and seeds such as black pepper, cinnamon, cloves, coriander, cardamom, chillies, cumin

seeds, fenugreek, garlic, ginger, mustard, poppy seeds, turmeric, mace, nutmeg, curry leaves, white pepper, saffron and aniseeds. The material may contain added starch and edible common salt. The proportion of spices used in the preparation of curry powder shall be not less than 85.0 per cent by weight. The powder shall be free from dirt, mould growth and insect infestation. It shall be free from any added colouring matter and preservatives other than edible common salt. The curry powder shall also conform to the following standards:

Moisture : Not more than 14.0% by wt.

Volatile oil : Not than 0.25% (v/w) on dry basis.

Non-volatile ether extract : Not less than 7.5% by wt. on dry basis.

Edible common salt : Not more than 5.0% by wt. on dry basis.

Ash insoluble in dilute HCl : Not more than 2.0% by wt. on dry basis.

Crude fibre : Not more than 15.0% by wt. on dry basis.

Lead : Not more than 10.0 p.p.m. on dry basis.

The names of spices contained in the curry powder shall be given on the label in descending order of composition on wt/wt. basis.

A. 05.21.01—**Mixed Masala (Whole)** means a mixture of clean, dried and sound aromatic herbs and spices. It may also contain dried vegetables and/or fruits, oilseeds, garlic, ginger, poppy seeds and curry leaves. It shall be free from mould growth and insect infestation The proportion of extraneous matter shall not exceed five per cent by weight, out of which the proportion of organic matter including foreign edible seeds and inorganic matter, shall not exceed three per cent and two per cent, respectively. The names of the spices contained in the mixture shall be indicated on the label in descending order of composition by wt.

Note:—Condiment is an appetising and usually pungent substance of natural origin (as pepper, vineger or mustard); any various complex compositions having similar qualities (as curry, or chilly powder, pickles, or catsup) Hansraj vs. State,

1977 Cri LJ 92 (Delhi) relying on Webster's New Third International Dictionary.

Chilly powder is a condiment and not a spice, Hansraj vs. State, 1977 LJ 92 (Delhi); See also 1978 Cri LJ 1166 (Bom).

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GLOSSARY OF TECHNICAL AND BOTANICAL TERMS

Allelomorph: One of a pair of contrasting unit characters.

Alluvial: Stream or river-laid deposits on soil.

Anaerobic: Pertaining to bacteria or other organisms which flourish without free oxygen.

Angiosperm: Any plant of the class having the seed in a closed ovary.

Annulate: Having rings or ring-like segments.

Aromatic: Fragrant, spicy.

Anther: The pollen-bearing part of stamen.

Anthesis: The time of process of expansion in a flower.

Axil: The angle formed by a leaf or branch with the stem of the plant.

Axis: The central line of any organ or a support of a group of organs; a stem, etc.

Biennial: Living for two years under normal, outdoor conditions, usually producing seed in the second year.

Buffer: Material or substance which prevents sudden change in acidity.

Bulb: A subterranean leaf bud with fleshy scales or coats.

Calyx: The outer perianth of the flower.

Canker: A disease in plants—localised lesions on stems which generally result in the corrosion and sloughing away of tissues with the final production of an open wound.

Carbohydrates: Any group of organic compounds composed of carbon, hydrogen and oxygen.

Catalytic: Pertaining to chemical action in which the speed of the reaction is hastened or retarded by a substance which does not enter into the end products.

Cellulose: A shapeless white compound, insoluble in all ordinary solvents, forming the fundamental material of the structure of plants.

Chlorophyll: The green colouring matter of plants.

Chloroplast: The plastid containing chlorophyll developed in cells exposed to light.

Chlorotic: Lack of chlorophyll, giving the plants a blanched appearance.

Chromosomes: A number of well-individualised units in the nucleus, each of which in turn, has a characteristic organisation.

Clove: One of a group of small bulblets produced by the garlic plant. Clove is also another well known tree spice of commerce.

Colloids: Uncrystalline materials, often gelatinous which diffuse slowly or not at all.

Connate: Born or originated together, agreeing in nature.

Corm: The elongated fleshy base of a stem, ball-like but solid as in saffron.

Cordate: Heart-shaped.

Corolla· The inner-perianth of distinct or connate petals.

Cotyledon: A seed leaf or first leaf of an embryo.

Crenate: Having the margin round-toothed, scalloped.

Cuticle: A continuous layer of structureless, waxy substance which covers the aerial parts of vascular plants except the growing points.

Cutin: A waxy substance which covers most of the aerial parts of vascular plants.

Cytoplasm: A more or less transparent, viscous fluid constituting all the protoplasm except the nucleus.

Dextrin: A shapeless, brownish white carbohydrate substance.

Dibble: An instrument for making holes in which to insert plants or bulbs.

Dicotyledenous: Having two cotyledons.

Diffusion: The passage of molecules or ions in solution from one part of the solution to another, especially through a membrane.

Dihybrid: A cross which involves two character differences.

Dioecous: Unisexual with the male and female flowers on separate plants.

Dominant: A parental character which has the ability to express itself in the resulting hybrid offspring.

Elliptical: Similar to oblong but with continuously rounding sides.

Emasculation: Removal of stamens.

Embryo: An organism in the early stages of development as before hatching from an egg or sprouting from a seed.

Endodermis: A sheath composed of one or more layers of modified parenchymatus cells which encloses certain fibrovascular bundles.

Endosperm: The stored food supply in a seed.

Exosmosis: The diffusion of solvent or solute outward from the cell vacuole.

Family: A division of an order. Usually a family comprises two or more genera but one genus possessing sufficiently distinctive characters may form a family.

Flora: The aggregate of plants growing without cultivation in a country or a district or indigenous to a particular geological formation, as a desert flora.

Floret: A small flower usually one of a dense cluster.

Foliar: Of, pertaining to, consisting of or resembling leaves.

Fungicides: Anything that kills fungi or destroys their germs.

Gene: That portion of the chromosome which serves to transmit characters from parents to progeny.

Genotype: The constitution of an organism with respect to factors of which it is made up, the sum of all genes.

Genus: A classificatory group of animals or plants embracing one or more species.

Herb: A plant with no persistent woody stem above the ground.

Hermaphrodite: Being of both sexes.

Homologous. Alike, similar or same.

Hybrid: The offspring of plants or animals of different genotypes, varieties, species or genera.

Hybridization: The practice of crossing between genotypes.

Indehiscent: Not opening by valves, etc., remaining persistently closed.

Inflorescense: General arrangement and disposition of flowers on an axis; flower cluster.

Inoculation: The process of improving soils by the introduction of special micro-organisms.

Insecticide: A chemical or a substance used to destroy or kill the insects.

Internode: A portion of stem between two nodes or joints.

Keel: The two anterior united petals of a butterfly-like flower e.g. a bean flower.

Lanceolate: Widening above the base and gradually tapering upwards to a point. Much longer than broad, lance-shaped.

Lignin: A substance related to cellulose with which it constitutes the essential woody part.

Longevity: Length of duration of life.

Mericarp: One of the two carpels that compose the fruit of a plant of the parsley or carrot family.

Molecule: A unit of matter, the smallest portion of an element or a compound which retains identity in character with the substance in mass.

Monocotyledon: Plant having only one cotyledon.

Monoecious: Having both sexes on the same plant.

Mosaic: Diseases characterised by mottling of the plant due to spots of light green or yellow on dark green leaves.

Mulches: Any substance e.g. straw used to protect roots of plants from heat, cold or drought or to keep fruit clean.

Mutation: A hereditary change in the character of an organism.

Mycelium: The vegetative body of a fungus composed of threads.

Necrosis: A disease causing plant tissue to turn black and decay.

Nodule: A knot, lump, or node on the roots of plants.

Nucleus: The more or less centrally situated organ of the cell containing the chromatin, known as the hereditary substance.

Oblong: When nearly twice or thrice as long as broad and of uniform breadth.

Obtuse: With a blunt or rounded apex.

Oval: Broadly elliptical.

Ovary: In angiosperms, an enlarged portion of the pistil containing ovules.

Ovate: Shaped like a lengthwise sector of a hen's egg. Somewhat oval with broader end downward.

Palmate: Resembling the open hand.

Panicle: A loose irregularly compound inflorescence with pedicellate flowers.

Parenchyma: The fundamental tissue, usually composed of thin-walled cells, making up the bulk of the substance of the leaves, the pulp of the fruit, the pith of stems, etc.

Pectin: A carbohydrate derivative occurring in many vegetable tissues as a part of the sap or cell-wall.

Pedicel: The stalk that supports one flower only.

Peduncle: A flower stalk.

Perianth: The floral envelope, consisting of the calyx and corolla (when present), whatever their form.

Pericarp: The wall of the ovary or ovaries when developed or ripened into fruit, the mature ovary.

Pericycle: A thin cylinder of tissue sheathing the vascular tissues.

Periderm: The cortical tissue derived from the phellogen (cork cambium).

Petiole: The foot stalk or stem of the leaf.

Phenotype: A type or strain of organisms distinguishable from others by some character, whether this character be due to heredity or environment.

Phloem: Part of the conducting tissue of plants usually thought to be instrumental in the conduction or transport of elaborated food from the leaf to the storage organ and growing regions.

Photosynthesis: A process of manufacturing food.

Pigment: Colouring matter, specially in the cell or tissue.

Pistil: The seed bearing organ of a flower consisting of the ovary, stigma and style when present.

Pith: A roughly cylindrical body of tissue in the centre of the axis, enclosed by vascular tissues.

Plastid: A unit of protoplasm.

Plumule: Dust-like male bodies capable of fertilization of ovules.

Pollinate: To transfer the pollen from the stamens to the pistils.

Progeny: The descendants of a single plant or pair of plants.

Propagate: To cause to multiply.

Protein: Any of several organic nitrogenous compounds.

Protoplasm: The living substance within the cell.

Pubescent: Covered with down or soft hair.

Recessive: Pertaining to a characte which is subordinate to or marked by an allelomorphic character.

Receptacle: The more or less expanded or produced portions of an axis which bears the organs of a flower or the collected flowers of a head.

Reniform: Kidney-shaped.

Revolute: Rolled backward from the margins of the leaf.

Rhizome: A root-like stem growing under the ground.

Rouge (Noun): An off-type plant or diseased plants.

Rouge (Verb): To remove off-type or diseased plants.

Rugose: Covered with or full of wrinkles or corrugate.

Sclerotium: A compact, waxy or horny mass of hyphal tissue found in certain higher fungi.

Seed: An embryonic plant with its surrounding integuments or coats.

Sepal: A leaf or division of the calyx.

Sheath: A tubular envelope, as in the lower part of the leaf in grasses.

Spatulate: Rounded above and gradually tapering down to a narrow base.

Species: A classifactory group of plants or animals subordinate to a genus and having members that differ only slightly among themselves.

Sperm: A mobile, celiated male reproductive cell.

Stamen: A pollen bearing organ of a flower.

Stigma: The part of the pistil which receives the pollen in pollination.

Stipule: An appendage at the base of the petiole of a leaf.

Style: The extended portion of a pistil connecting stigma and ovary.

Suberin: A fatty or waxy substance characteristic of cork tissue.

Sucrose: A non-reducing sugar, the most common commercial sugarcane or beet sugar.

Suffrutescent: Having the character of an undershrub or suffrutex, slighty shrubby.

Suffrutex: An undershoot having a decidedly wooden stem.

Sulcate: Having long narrow furrows or channels grooved or fluted.

Truncate: Having the end square, appearing as if cut off.

Tuber: A short thickened underground stem having numerous buds or eyes.

Umbel: A flower cluster in which the flower stalks spring from the same point as in a wild carrot.

Umbelliferae: Having the mode of flowering called an umbel; a plant which bears umbel.

Undulate: Wavy, rippling.

Unisexual: Of one sex—either male or female. Not hermaphrodite.

Viability: Alive or ability to remain alive.

Virus: A group of materials acting poisonously, produced and increased within the plant.

Vitamins: A group of food substances other than fats, carbohydrates, proteins and minerals/salts which are essential to nutrition and serve to prevent diseases.

Volatile: Capable of rapid evaporation in air at ordinary temperature.

Whorl: A group of organs arranged about a stem, arising from the same node.

Xylem: A part of the vascular bundle or conducting tissue.

GLOSSARY OF MEDICAL TERMS

Adrenal cortex: Cortex, covering. Adrenal covering.

Amoebic Dysentery: A form of dysentery caused by a certain kind of amoeba—a type of protozoa, consisting of unit/mass of living matter and flowing out in all directions.

Anti-spasmodic: Relieving or preventing spasms, a remedy or preventive for spasms.

Arteriosclerosis: Hardening of arteries.

Atony: Want of tone or energy, debility, relaxation.

Atonic Dyspepsia: Atonic: caused by or characteristic of atony. Dyspepsia: impaired digestion, indigestion.

Autopsy: Personnel inspection, examination of body after death.

Blood Stasis: The arrest of blood in its circulation.

Bronchitis: An inflammation, acute or chronic, of the mucous lining of the bronchial tubes.

Bronchectasis: Bronchitis, inflammation of the bronchiae.

Carminative: Expelling gas from the stomach and intestines, a carminative medicine.

Colic: Acute abdominal pain caused by various abnormal conditions in the bowels.

Diaphoretic: Producing or increasing perspiration; a diaphoretic medicine, treatment.

Distension: Act of distending or stretching, state of being stretched.

Diuretic: Increasing the secretion and flow of urine.

Duodenal Ulcers: Ulcers of the duodenum.

Dyspepsia: Impaired digestion or indigestion.

Enema: Injection of a liquid into the rectum either as purgative or as medicine clyster to wash out the rectum.

Expectorant: Causing or stimulating expectoration to cough up and spit.

Fibrin: A protein substance which appears in the blood after it is shed, giving rise to the process of coagulation or clotting. (Fibrinolysis).

Flatulence: Gas or wind in the stomach or intestines.

Fundus: The bottom of anything, the rounded base of a hollow organ.

Gangrene: Decay of tissue in a part of the body when the blood supply is obstructed by injury diseases, etc.

Garnishing Agent: That which garnishes or embellishes ornament, apparel or trimming.

Gastroenterology: Pertaining to the stomach.

Helminthic: Expelling or destroying helmints, helminthic medicine.

Lupus Ulcer: Lupus—a chronic tuberculous disease of the skin or mucous membrane characterised by the formation of reddish-brown nodules. Ulcer—an open sore on the skin.

Mobility: Characterised by motion.

Mucin: An alkaline glutinous fluid forming the chief constituent of mucus.

Mycotic: Caused by a mycosis—the growth of parasitic fungi in any part of the body.

Oedema: Also spelled as Edema—a swelling, an abnormal accumulation of fluid in cells.

Pharmaceutical: To use medicines of pharmacy.

Prophylactic effect: Guarding against.

Prophylaxis: Guarding against.

Pulmonary Phthisis: Pulmonary: affecting the lungs. Phthisis: a wasting away of the body, or any of its parts, especially in tuberculosis of the lungs: consumption.

Pylonus: Leading to intestines, lower opening of the stomach.

Rubefacient: Causing redness, as of the skin. Any external application of the skin.

Spasmodic: Causing intermittent spasms characterised by emotional outbursts or excitability.

Suppurating Wounds: Wounds having pus.

Therapy: The art of healing.

Therapeutic: One who treats medically, serving to cure or heal; curative.

Thrombocyte: Platelet essential for clotting.

Thrombosis: An affection of the blood vessels (either veins or arteries), which essentially consists in a coagulation of blood, forming a true clot, at certain fixed spots.

INDEX

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First handbook on spices by Dr. J.S. Pruthi, who is an internationally well-known spice expert, covers nomenclature, description, distribution, physical and chemical properties, and uses of about seventy spices, which would be of special interest to the reader. The names of different spices in different Indian languages have also been given for correct identification of each spice. The various uses of spices in foods and beverages as flavourants in medicine, in perfumery and cosmetics are described. It also covers latest PFA Quality Standards for spices.

The author, Dr. J.S. Pruthi (b.1921), is an internationally well-known authority in Spice Technology. He has the unique world distinction of being the only scientist who has authored 5 technical books on different facets of spices, including 1 published in USA and another in Germany. In addition, he has also authored 4 more books on Food Technology of which two have been approved as textbooks for graduate and post-graduate students in Food Technology in India. He has over 47 years experience in the line. He has also been the *Founder Director*, Agmark Laboratories, Govt. of India, *Founder Director*, CSIR Industrial R & D Complex, one of the *senior most Founding Scientists* of CFTRI, Mysore and one of the oldest post-graduate teachers in Food Technology in India. He has authored 6 *patents* (including 3 on spices), 300 publications in Food Technology (including 100 on Spice Technology) and 9 books. Some of his *outstanding patents* and publications have won him *15 national* and *international awards*, including the covetous *NRDC award*. He has led several Indian delegations of experts to ISO-International Conferences for formulating World Standards for spices and spice products. He has also been thrice Adviser to the Commonwealth Secretariat, London, for advising and addressing international spice congresses. He superannuated in 1981 and since then he has been advising Food Industries in India and abroad in Spice Technology, Fruit/Food Technology.

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